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KING RICHARD'S BARBECUE.

Richard, the lion-hearted, ere from England he departed
For the land of distant Palestine, the infidel to fight,
Gave a tourney at the castle—jousting, archery and wrestle,
And a banquet in the hall of state on St. Matthias night.

And the feast was grand and royal; and of peers and princes loyal
A hundred there were gathered, and of knights twelve score and nine
That fortune had befriended, while those the leech attended
Had glory's meed for valor's deed in pledge of royal wine.

The bishop lent his blessing, nought of holy rules transgressing;
With proofs of many a precedent the chronicles abound;
And beside the monk and prior sat the bards of famous lyre;
And with music, song and merriment the flagon passed around.

Ere the festival was finished or the revelry diminished,
A sage of aspect hoary to the banquet made his way;
His entrance none contested, though attention was arrested;
Scholastic lore the priest forebore and minstrels ceased to play.

Up the hall the seer advances, 'neath a thousand curious glances,
Crowds of lackeys, pages, grooms and guards in wonder press before;
While assistants, close behind him, as though they meant to bind him,
Dragged a line of copper wire from behind the portal door.

Was he king-at-arms or herald grand, a palmer from the Holy Land,
Or another Hermit Peter, come to preach a new crusade?
But neither cowl monastic, nor herald's dress fanastic,
Nor pilgrim's guise, to courtiers' eyes the stranger's rank betrayed.

Unearthly lights flashed o'er him, and a page who walked before him,
Bore some noisy thing imprisoned in a small metallic case,
Which, like elfin hammers pounding, made a din the ear confounding;
And this train uncouth obeisance made before the royal place.

"Mighty Monarch," cried the stranger, "there is neither harm nor danger
In this wonderful invention which I purpose here to show
(With your Majesty's permission); 'tis a means of quick transmission
Of certain signs which yonder lines bear swiftly to and fro.

"It has cost much time and treasure thus to work your royal pleasure;
On posts of oak and Spanish yew our mystic line is bent;
Through the forest, over mountain, nought of toil or danger counting,
We have built it straight to Nottingham upon the River Trent.

"To this point and nearer stations can we send communications;
Your royal mandate swiftly will we flash through yonder land;
By our mystic wire aided, ere the morning star has faded,
Priest, peasant, peer alike shall hear your Majesty's commands."

Roared the king with some suspicion: "By St. George, a curious mission."
Then spoke Prince John of Anjou (he of Magna Charta fame):
"Have a care, most valiant Diccon, lest my liege they play some trick on,
Though to lose this grand invention now would be a burning shame.

"Lo! our gentle mother boasted, ere her forces northward posted,
That in the week she'd halt before the gates of Nottingham;
Can the wizard spy her banner?" Said the king in blandest manner:
"Tell us, seer, if aught you hear of our most gracious dam."

Then the wizard grasped his wire, and a myriad sparks of fire
Filled the place around about, from which the courtiers shrunk with fear.
Weird, magic feats displayed he, but at length this answer made he,
As his box of castanets he took and held up to his ear:

"In Nottingham the riot is subdued to sternest quiet;
From those grim and lofty battlements the royal banner flies;
And the city's peace is troubled, and the warder's guard is doubled,
For Henry's dame of honored fame within the castle lies."

Said the king: "There's no deceiving. By the rood, 'twere past believing,
But this gramarye took place before our very eyes.
'Tis a wonderful invention, though beyond our comprehension,
And an instrument most potent that ourself will patronize."

Then to a trusty warder gave the king a secret order,
Who left the hall in haste and from the castle quickly sped,
But returned within the hour with the headsman from the Tower,
Who stalked before and grimly bore a ghastly human head.

No need is there to name it, for the features stark proclaim it
The head of one long trusted with the high affairs of state.
The guests their fears dissembled, though the stoutest warrior trembled,
As Richard coolly held to view the baron's gory pate.

"Send this to Queen Eleanor; note sharply her demeanor
As the trophy you deliver: then to name your guerdon true
For these uncouth commissions, my king of all magicians—"
"Holy St. Bride!" the stranger cried, "so name me if I do."

"No art, my liege, can do it, and our power you misconstrue it;
No earthly weight or matter can we send across the land:
Not the gem your finger presses, not a lock from maiden's tresses,
Not a single drop of water nor the tiniest grain of sand.

"But our mystic spark is driven like the thunderbolt from Heaven;
No mortal eye may trace its course or mark it in its flight:
This wondrous force subjected, by our skillful art directed
To use of man, will distance span and instant signals write."

Then King Richard 'rose in ire, hurled his mantle in the fire,
And his suit of Milan armor he splintered into tacks;
And his courtiers fond he scattered, and the festive board he shattered,
And his diadem he battered with his ponderous battle-axe.

Cried the bishop: "This delusion ends in wrath and dire confusion.
'Tis the instrument of satan and the black art's magic wand:
Once the land is well surrounded, with this goblin wire bounded,
Then with our souls to burning coals the devil will abscond.

"But their arts they practice vainly, for, my son, 'tis written plainly
That all dealers in foul witchcraft with the fiend make common cause:
By their fruits you may discern them, and with faggots shall you burn them;
So saith the Scriptures, blessed saints, and high monastic laws.

"If your weal you well consider, then to holy church deliver
These unhallowed posts of oaken wood and poles of Spanish yew;
With their infernal wire will we crown this mighty pyre,
And on it make, for conscience sake, a pious barbecue."

Then the conjurers grew tearful, but the king appeared more cheerful,
And he bade his page to bring him straight a tankard filled with wine;
And he swore by satan's muzzle but that slender stoup he'd guzzle
Till he'd barbecued the wizard gray upon his magic line.

In the market place of London were those necromancers undone,
In the presence of the populace and England's king and peers;
And to this mad invention people gave no more attention
Till Lincoln's bell had rung the knell of twice three hundred years.

THOMAS C. NOBLE, JR.

The Western Union Main Office in this City.

The Western Union building in New York is situated on the corner of Broadway and Dey street. It is generally known among the employés as "195," that being the number—or one of the numbers—the building occupies on Broadway. The operating room is on the seventh floor, about 100 feet from the ground. A balcony which extends around the building on the Broadway and Dey street sides, on the level of this floor, being high above the adjacent buildings, commands a splendid view of Jersey City, Staten Island, the Narrows and Brooklyn.

The operating room is 145 feet long and 70 feet wide, and the ceiling is 28 feet high. The floor is of artificial stone or cement, of the style known as the "Beton coignet." The room is unobstructed by supports of any kind except at its eastern end, where four iron pillars bear the massive iron work of the tower above and tend to support the gallery recently erected for the Commercial News Department.

In the day time the room is well lighted by 42 windows, and at night by ten pendant chandeliers, having an aggregate of 80 gas jets. The gas will, however, soon be superseded by the Edison incandescent electric light, which is now being introduced into the building. The room is admirably adapted for its purpose, except, perhaps, in the one item of proper ventilation, which appears to have been overlooked in its design. It is stated, however, that arrangements are now progressing to rectify this oversight by the insertion of suitable ventilators in the ceiling.

When all the instruments are in operation, the air is full of sound and it is always a source of surprise to visitors that the operators are able to distinguish one signal from another. That they have no difficulty in doing so is due in a great measure to the non-resonant character of the floor, the very high ceiling and the fact that each desk is separated from the adjoining ones by a thick clear glass partition; thus there are no distinctly sharp strokes of instruments to distract the ear.

In the centre of the room are the termini of the system of pneumatic tubes, connecting the operating room with all the other floors of the building and, by means of the underground tubes, with the New York Stock Exchange, at No. 8 Broad street, No. 134 Pearl street, and the Central Cable Office at No. 16 Broad street. The latter tube is also led into the office of the Direct Cable Company, No. 120 Broadway, which office intercepts, by means of a switch, business intended for it.

The underground tubes are made of brass and are two and one-half inches in diameter. Messages are placed in a leather-covered box which fits the tubes closely. The lever is then pulled out, which action opens a valve at the mouth of the tube and by the same motion shuts off another valve about 12 inches above; the box is inserted in the tube, the lever is pushed in, closing the lower and opening the upper valves and letting on the air pressure, by which the box is forced to its destination. The most distant office, No. 134 Pearl street, is about half a mile from 195 Broadway. The box traverses this distance in one minute and the shorter distances in 50 seconds. All of these tubes have electrical arrangements whereby on the arrival of a box a bell or "buzzer" is started which rings until the box is removed by an attendant.

The main office terminals of the underground tubes are arranged so that they can be converted into sending or receiving tubes at will. Pressure is used in sending boxes from the operating-room, and suction in returning them. The air pressure is supplied by a fan placed in the subcellar. This method of relaying branch office business is a great saving of time and labor over the old system of telegraphing the business by short wires to the general office, as a batch of 25 or more messages may be sent by tube in the time formerly taken to send one by wire. It is understood that underground pneumatic tubes will be laid during the present spring between 195 Broadway and the corner of West Twenty-third street and Broadway.

It was thought, when the Western Union building was erected, a little over eight years ago, that the operating-room would be large enough to meet the increase of business for a score of years. At that time not more than half of the available room was necessary, and perhaps nothing better serves to show the rapid growth of the telegraph business in this country within the past few years than the fact that not only have all the spare desks been pressed into service, and all the main aisles bridged over with new desks, but the Commercial News Department, which formerly occupied the east end of the room, has been crowded out of its quarters into the gallery previously mentioned.

At the time of the occupation of this room, Feb. 1, 1875, the entire force consisted of 290 employés—215 males and 75 females. There were then in use 149 Morse instruments, 6 Phelps printing instruments, 15 duplex and 7 quadruplex sets. The daily number of messages sent and received amounted to 24,000, in addition to 89,000 words of

press. Now there are employed in the operating room, exclusive of the Commercial News Department, 453 operators—343 males and 110 females and 75 clerks and messengers. There are now in use 200 Morse instruments, 28 duplex and 48 quadruplex sets, and 6 sets of the Phelps motor printing instruments.

The quadruplex system is in operation between New York and Chicago, with repeaters at Buffalo; to North Sydney, C. B., distant 1,165 miles, with repeaters at Bangor, Me.; to New Orleans, distant 1,374 miles, with repeaters at Lynchburg, Va., and Atlanta, Ga.; occasionally to Galveston, Tex., distant 1,774 miles, with additional repeaters at New Orleans, and to Milwaukee, with repeaters at Chicago. There are also direct quadruplex circuits to Buffalo, Cincinnati, Pittsburgh, New London, Conn., Norwich, Conn., Albany, N. Y., Augusta, Ga., etc. Between New York and Boston there are 11 quadruple x circuits in operation, 5 sets of which are leased to brokers, each set accommodating two or more firms. Several sets are held in readiness for use on special occasions, such as political conventions, international rifle matches, etc. On such occasions the usefulness of the quadruple x system is palpable, quadrupling as it does the capacity of the one wire which may, under ordinary circumstance, be sufficient to transact the regular business of the places selected for the above purposes. A number of these sets are also employed during the summer season between New York and the various watering places. Several sets are likewise set apart for the use of branch offices, the principal of which are the Central Cable office and the New York Stock Exchange office, these being connected with the quadruple x systems by means of loops from 195 Broadway. Thus, for each quadruple x set there are two sending and two receiving wires running from the main to the branch offices. To facilitate the handling of these loops, of which there are about forty, Mr. S. S. Bogart has designed a loop switch, by means of which any loop may be transferred from one quadruple set to another, or from one side of a set to another, or to a single wire, without a moment's delay. This switch is in the rear of the main switch.

The main switch is situated on the north side of the room, Its frame is 37 feet long and 9 feet wide. It is divided into eight sections or panels, each 4 feet square, separated from each other by plates of looking-glass. The switch is supported by a mahogany counter, 4 feet high. Into this switch run 110 wires from the East, 139 from the South and 96 from the West, and it has capacity for a great number of loops. The city line switch is in the southwest corner of the room, there being led into it 119 city wires and 25 from Long Island, making a total of 582 wires, exclusive of the wires of the Commercial News Department, of which there are 103, making a grand total of 685 wires coming into the room.

The wires come into the building at all points, but principally at the north and west sides. On a level with the battery room, wrought-iron fixtures are placed against the building, bearing wooden pins and glass insulators, to which the line wires are brought. The leading-in wires enter above the windows through insulated tubes and are connected with lightning-arresters which extend along the wall near the ceiling. From these arresters the wires are led into their appropriate switches, whence they are looped to any desk designated in the operating room, thence to the dynamos and ground. Mr. S. S. Bogart is in charge of the wire system of New York and vicinity.

The electromotive force necessary to the working of these circuits is generated on the floor next below the operating room. This room extends the full length of the building, and all of it was formerly occupied as a battery room, but since the introduction of the dynamo-electric machines a great many gravity cells have been dispensed with, and now a considerable portion of the room is used as a coat room for the male force. The ladies' cloak room is also now on this floor.

There are at present some 3,600 cells of gravity battery in use by the Western Union, almost entirely as local batteries. The electromotive force for the main wires is furnished by dynamo-electric machines, of which there are 15 on this floor, in series of 5 machines. Thus there are 3 series. Two of these series are kept in operation day and night, the other series being reserved for emergencies or to allow of necessary repairs. The motive power for these machines is supplied by three safety steam-power engines of six horse-power each, which derive their steam from boilers in the sub-cellar. Of these series or gangs of 5 machines, one machine is used to generate a magnetic field for itself and the four other machines. It also determines the polarity of the series according to the direction of its current around the field-magnets of the other machines. One of the active series supplies negative, the other positive polarity to the wires.

The polarity of the spare series may easily be changed to positive or negative by means of a switch arranged for the purpose in the battery room.

Four grades of potential are furnished from each series of these machines, in the manner hereafter described,

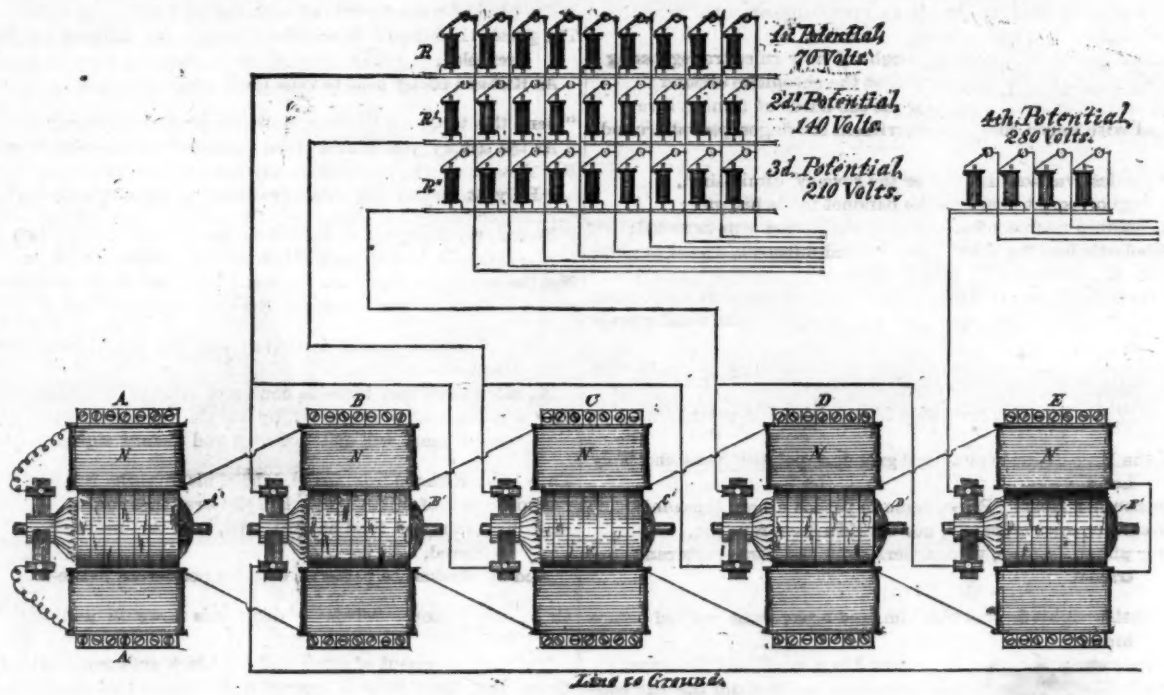
Artificial resistances, equal to 3 ohms per volt, composed of coils of German silver wire wound on cylinders of prepared plaster of paris, are interposed between each machine and every wire leaving the switch as shown in the engraving. Thus the resistance of each coil interposed between the first potential and the wires is about 200 ohms; between the second potential and wires, 400 ohms; between the third potential and wires, 600 ohms, and between the fourth potential and wires, 800 ohms. These coils serve to diminish the intensity of the dynamo current, thereby obviating sparks and to prevent, in a measure, the burning of instruments in case of the short circuiting of a wire. The first, second and third potentials are conducted to the main switch, the first and second potentials only to the city line and Long Island switch.

The fourth potential is used principally to supply very long quadruplex circuits, such as those to Bangor, Me., Lynchburg Va., &c.

Wires having an average resistance of about 3,000 ohms are supplied from the first potential. Those having an average resistance of about 5,500 from the second potential. The third potential is mainly used for duplex and quadruplex circuits. The New York City, Brooklyn and Jersey City wires, being generally of low resistance, are also supplied from the first potential; but the resistances of those wires are increased by means of resistance plugs, inserted at the switch in their circuits, to an average resistance of from 3,000 to 4,000 ohms.

The illustration gives an outline view of one series of the dynamo machines, showing the manner in which the several potentials are derived and the method of interposing the artificial resistance coils previously mentioned.

A, *B*, *C*, *D* and *E* are the five dynamo machines of one series. *A* is the feeder which furnishes the magnetic fields for itself and the four other machines. *A'*, *B'*, *C'*, *D'* and *E'* are the armature coils of each machine. The rear of a portion of one section of the main switch in the operating room is shown above the machines. To simplify the illustration, neither the belting gear of the machinery nor the polarity changing switch in the battery room are shown.



THE DYNAMO-ELECTRIC MACHINES.

The plaster of Paris cylinders, around which the artificial resistance coils are wound, rest on horizontal strips of brass. The lower terminal of each coil is attached to the brass support and the upper terminal is conducted to a small disc on the switch. The perpendicular strips on the switch are each connected to one line wire, so that by means of a brass plug inserted between a disc and a strip the first, second or third potential of current may be placed to the line as desired.

The second machine *B* supplies the first potential of about 70 volts, when is conducted to the brass supports of the resistance coils *R*, and thence to the switch, as shown.

The third machine *C* also supplies an electro-motive force of 70 volts, which being reinforced by the 70 volts generated by *B*, raises the net potential to 140 volts, which is conducted to the switch as the second potential. In like manner the fourth machine *D* supplies another 70 volts. This being added to the electro-motive force of *B* and *C*, increases the potential to 210 volts, which is also conducted to the switch as before, excepting where it is used to supply a quadruplex or duplex circuit, when it is conducted directly to the instruments, after passing through special resistance coils.

The last machine *E* also generates an electro-motive force of 70 volts, thereby increasing the total electro-motive force of the series approximately to 280 volts potential. As previously stated, this fourth grade is used only for the longest quadruplex and duplex circuits. Some of the machines have fewer convolutions on the armatures than others, but these are run faster to compensate. The internal resistance of each of these machines is about $\frac{1}{4}$ of an ohm.

The quantity of current generated by these machines would appear to be almost limitless. Already over 300 wires of an average resistance of about 3,000 ohms are supplied from the first potential without any preceptible diminution of the current or appreciable effect on the working of the machine, hence the great economy of the system, of which Mr. Stephen D. Field is the inventor. Mr. O. A. Brown is the engineer in charge of the machines in 195 Broadway.

Mr. James Merrihew, assistant general superintendent, makes the operating-room his headquarters when in the city. Mr. Wm. J. Dealy is manager of the operating-room. The working-staff of this department is divided into day and night forces, and these two forces are divided into various sub-divisions and sub-departments, as follows: On the day force, Mr. T. Brennan is acting assistant manager; on the Eastern Division, Mr. Fred Catlin is chief operator, with Mr. D. W. McAneeny as assistant; Southern Division, Mr. F. W. Gregory, chief operator, Mr. D. B. Mitchell, assistant, and Mr. M. M. Davis, traffic chief; Western Division, Mr. Jos. B. Stewart, chief operator, Mr. G. M. Stainton, assistant, and Mr. M. Labaugh, traffic chief; South-Western Division, Mr. F. W. Baldwin, chief operator, Mr. W. H. Hoyt, assistant, and Mr. T. J. Landy, traffic chief; City Line and Long Island divisions, Miss F. L. Dailey, chief operator, and Miss K. E. Donohue and Mr. Lant S. Jones, assistants. On the night force, Mr. A. E. Sink is manager, and Mr. J. H. Dwight, assistant manager; Eastern and Southern Divisions, Mr. T. G. Kennedy, chief operator, and Mr. E. M. Anson assistant; Western Division, Mr. J. B. Sabine, chief operator and Mr. F. Fisher, traffic chief. The "all night" chief is Mr. T. Tobin, assisted by Mr. E. F. Howell. On the City Line and Long Island divisions Mr. E. F. Cummings is chief operator, with Mr. W. H. McEnroe as assistant.

There is also the Commercial News Department, with Mr. J. H. Townsend as manager, Mr. G. M. Schuster, chief operator, and Mr. A. Waldron, wire chief.

The Marine Department is in charge of Mr. Jas. McParland.

The recently introduced Wheatstone Department is under the supervision of Mr. S. P. Freir, with Mr. R. D. Reilly as wire chief and Mr. H. Mitchell as mechanic and engineer. The working force of this department at present consists of eight perforators or punchers and copyists.

Mr. R. G. Stephenson is day chief of the clerical and messenger force of the operating room. Mr. Jas. Elliott is night chief of the same force.

Messrs. J. M. Moffatt and P. P. Hauff, assisted by W. Maver, Jr., have charge of the quadruple sets assigned to the leased wires and cable circuits.

The number of messages now daily handled in the office ranges from 75,000 during the summer months to 55,000 in the winter season. The work of collecting, assorting and distributing this large business is assigned to the traffic department.

The main assorting and distributing table or counter adjoins the termini of the pneumatic tubes. As quickly as messages are received by these tubes, they are placed in appropriate receptacles at the side of the assorting counter, from whence they are taken by messengers and distributed to their various wire desks for transmission. There are two additional assorting desks, one at each end of the operating room. Every wire desk is furnished with a small wooden rack into which the operator slips each message as it is received. The collectors gather these messages and convey them to the nearest distributing table. Received city messages destined for persons within a certain radius of 195 Broadway are dropped down a perpendicular tube to the delivery department on the ground floor. Messages for the vicinity of the New York Stock Exchange and those for the Central Cable Office are sent by the underground pneumatic tubes to their destination, while all dispatches for the upper part of the city and Brooklyn are forwarded by wire from the city line department.

Visitors can only obtain access to the operating room by special permission.

Recently the operating room has been entirely renovated. The walls have been re-painted and frescoed, and it now presents a very handsome appearance.

Electric Lighting.—XXII.

THE LIGHT OF THE VOLTAIC ARC.—CONTINUED.

All rays of light are susceptible of reflection and of refraction but not in an equal degree. The more rapid the undulations of the ray, the more refrangible that ray is, and *vice versa*. This is shown by the spectrum or color image of sunlight (Fig. 70), whose production depends on

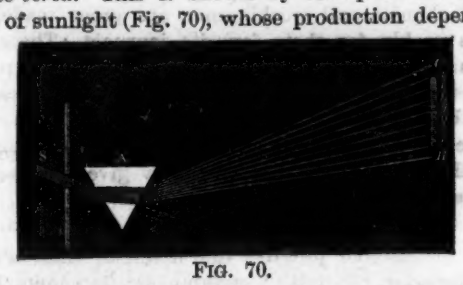


FIG. 70.

this difference of refrangibility. Into a darkened room a beam of light (*s*) is admitted through a small opening. This ray would naturally follow the straight course shown by the dotted lines, but it is intercepted by a triangular prism of glass *A*. Now, if the rays of light were all equally refrangible they would all have become bent equally and we would have the same round spot of light on the screen; but as just stated the most rapidly undulated rays or the violet, are refracted upward further than the others, while the most slowly undulating rays, the red, are bent the least, and hence the result is an elongated band of light wherein each different kind of rays occupies a distinct portion. Thus, the topmost portion is the violet, then come indigo, blue, green, yellow, orange and, lowest, the red, as indicated by the initials v, i, b, g, y, o, r. The beam of light may be said to be thus decomposed into its component factors. When a beam of light possesses all these rays in proper proportion the sensation perceived by the retina makes us call the light white, but if the beam contains an excess of red and yellow rays, then we call it a red or yellow light, and thus with any other color. An important fact is that whenever the rays vibrate in periods slower than the red rays, or in periods faster than the violet, they are not visible to the human eye, just as the audibility of sounds is limited by their slowness or rapidity of undulation. In point of fact, the spectrum of the sun's light contains rays beyond the red whose periods of vibration are too slow to affect the eye, and also other rays above the violet whose periods are too rapid to affect the eye. The former manifest themselves by their great heating effects, and are called for this reason "heat rays" (*H*, Fig. 70); the latter manifest themselves by a power to induce chemical changes or "actinic" effects, and for this reason are called "chemical rays" (*c*, Fig. 70). The bleaching effect of sunlight and its action on silver salts in photography, etc., are actinic effects produced by these rays. The actinic power may be tested by means of a silver salt such as is used in photography, by exposing it in the different colors of the spectrum and noting the degree of effect produced on it. The heat rays may be studied by means of a thermometer placed in the different portions. The actinic rays are slightly perceptible at the green, more so at the blue and quite pronounced at the indigo, though they reach their maximum at the violet or just beyond, after which they decrease. The heat rays begin at the violet, but are scarcely perceptible as far as the orange; they reach their maximum just below the red and then gradually decrease as the actinic rays do. Could we see the whole spectrum of the sun, including the visible and the invisible rays, it would appear much longer than the visible one, as shown in Fig. 71, for the reason that the portions *C* and *H* occupy a comparatively large space. When the solar spectrum is magnified it is found to be crossed at various points by a multitude of dark lines. These are called Fraunhofer lines, or "lines of absorption," and they indicate that in their passage through the solar atmosphere and through our own atmos-

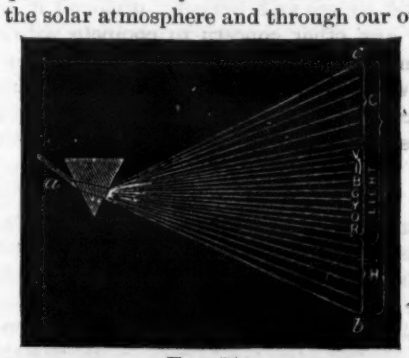


FIG. 71.

phere the vapors and gases have absorbed or intercepted some rays whose refrangibility would have made them occupy those portions of the spectrum. These lines are each peculiar to certain elements, and by introducing the same element into an artificial flame the same lines are caused to appear in its spectrum.

The rays of an ordinary fire when passed through a prism show mostly red and orange, with a few yellow rays, while the heat rays are comparatively abundant. The light of a gas flame shows a few more yellow and a few green and blue rays; there are no actinic rays perceptible.

The spectrum of the voltaic arc shows a remarkable resemblance to that of sunlight, as might be expected. It contains all the colors of the solar spectrum in proper proportions, which explains why this light gives a sensation of white light to the eye. The violet end of the spectrum is in reality more intense with the light of the voltaic arc, which explains the bluish tinge which we ascribe to this light. The spectrum of the incandescent carbons of the arc is a continuous band of pure bright colors, unbroken by light; but the spectrum of the arc itself is discontinuous, like the spectra of vapors, and shows the "carbon lines" in the blue portion, which sustains the inference that its light is caused by the glow of incandescent carbon vapor. The spectrum of the voltaic arc is also much richer in the ultra-violet or chemical rays; but M. Cornu has shown that this is because the earth's atmosphere deprives sunlight of many of its violet and ultra-violet rays, and it is plausible that were we to see the light of the sun from beyond our atmosphere it would look more "bluish" than it does now, like the electric light; or, on the other hand, were we to pass the electric light through the same thickness of atmosphere, it would look "whiter," like sunlight. It is not on the upper end of the spectrum, however, that the atmosphere exerts the greatest influence. The heat spectrum, or invisible portion containing the heat rays, is several times longer for the electric light than for sunlight, as shown in Fig. 72, where the curve *E C H A* shows the increase of heat from the upper end of the spectrum to the ower. It is seen that the "light" portion of the spectrum contains only a small portion of the heat energy of the spectrum. The invisible or heat portion, shown in black, contains several times as much heat energy. The point of maximum intensity (*H*) is also removed quite a distance from the red, and, finally, the lowest limit of heat space (*A*) is removed from the red by a distance lon ger than the length of the visible spectrum itself.

Prof. Tyndall has shown that this difference between the spectra of the sun and of the electric light is due to the absorption of heat rays by the watery vapor of the atmosphere, and he has succeeded in reducing artificially the heat spectrum of the electric light by passing it through water.

The electric light is accordingly a most rich light in all kinds of rays for the reason that it produces all kinds of rays and is not sensibly impoverished in any of them in

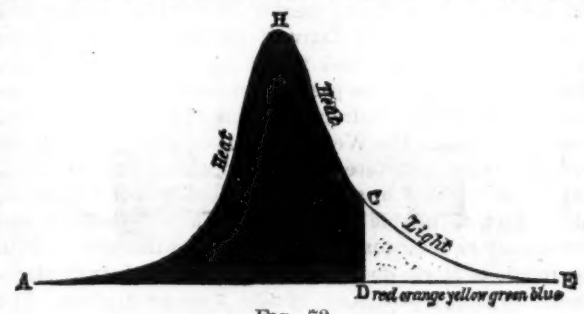


FIG. 73.

the short distance of atmosphere it traverses. However, the invisible portions of the spectrum are so much longer than the visible portions that it is evident a large proportion of the energy expended in their production must be totally useless. Thus, the heat spectrum of the arc (Fig. 72) shows that the invisible heat rays are nearly eight times in excess of the visible ones. In a word, of the heat produced in the arc only about one-eighth is utilized and appears as light. Moreover, a certain fraction of energy also disappears in the production of actinic or chemical rays, which are likewise invisible. Prof. Tyndall has stated that probably 90 per cent. of all the rays emitted in the arc are either thermic or actinic and are utterly inappreciable to the eye; in other words, only about one-tenth of the rays are visible and utilizable for lighting purposes. Surprising as this immense loss appears, it represents a great economy over all other artificial methods of producing light. With gas, according to Prof. Tyndall, only one three-hundredth of the rays are visible! The rest are all thermic or ultra red: none are actinic. It has been shown, in fact, that it would be better economy to use the heating effects of gas in gas engines for the production of electricity and then to convert the electricity into light, simply because the voltaic arc can convert a greater percentage of its energy into visible rays. It does this because its heat is more intense than any artificial heat, and thus emits rays whose undulations are more rapid. The calcium light approxima tes more closely to the electric light than any other, f or the reason that its heat approaches in intensity to that of the vo ltaic arc. By placing refractory materials like lime or m agnesia in the arc a great deal of the invisible thermic energy may be utilized in producing incandescence, and thus the light-giving economy of the arc may be increased. If we could increase the heat of the arc still more, no doubt the percentage of visible rays would be increased. There is reason to believe that the arc employing currents of greater volume, as from 20 to 30 ampères is more economical than that which employs currents of only 10 or 12 ampères. It is true that there is much more loss in the wires in the transfer of strong than of weak currents, but undoubtedly the increase of light produced makes up in great part for it. The fact that the constant reversal of the Peltier effect with alternate currents tends to keep the absolute temperature lower at either carbon than the temperature of the positive crater with continuous currents, probably explains also the loss of economy in alternate current lights.

The richness of the electric light in actinic and heat rays has been turned to account by Dr. Siemens in horticulture with very interesting results. He finds that plants grow faster and that the ripening of fruit is much promoted by the electric light. He finds that to a certain extent the plants may be urged to grow during the night as well as during the day, without "rest," for several days. The actinic rays of sunlight are held by many to possess hygienic and sanative properties, and not many years since it was proposed to filter them out of sunlight by "blue" glass for the cure of disease. Undoubtedly the actinic rays fulfill important functions in the animal as well as in the vegetable life economy, and as the electric light is much richer in these rays than sunlight is, we must look upon it as very 'healthy' indeed. C. O. M.

Will the Telephone Supersede the Telegraph?

The rapid development of the telephone and its many applications to the business and social life of the period are among the most surprising of the numerous astonishing revelations of modern applied science, and, judging from the outcome of some recent experiments in this direction, it would seem that we are as yet only on the verge of still greater results than those already obtained. Auditors and transmitters have been made more sensitive, and resistance and induction—the great obstacles to telephoning—have been materially overcome by ingenious devices. In consequence of these improvements it has been rendered possible for persons to converse without difficulty between this city and Cleveland, Ohio, over the peculiarly good conducting wires of the Postal Telegraph Company, and there are hopes that nearly as good results will soon be had with the ordinary telegraph wires. What the final outcome of experiments of this kind will be, it is difficult as yet to conjecture. That one result will be to enlarge the uses of the telephone, and make it more and more an adjunct of business methods, has already been demonstrated. The problem now is, will it take the place of the telegraph, and, if so, to what extent will it do this? The limit to a telephone's work is the rapidity of a person's utterance. The limit of the telegraph is constantly being extended, and we can already—in the duplex and quadruplex apparatus, and in the more recent devices of the Postal Telegraph Company which have succeeded so well experimentally—see results greater than any which depend on oral enunciation. For general business, indeed, it is hardly likely that the telephone will supersede the telegraph, but the former has a field of its own which is nearly, if not quite, as important, and it promises to create much new business while adding to the facilities for communication.—*N. Y. Times.*

Competition Encourages Invention.

The success of the Postal Telegraph Company with their new copper wires is another point of evidence against the plan of giving the telegraph business of the country into the control of the Government. It is an advance in the telegraphic science to be proud of, to have discovered and put in working order a wire over which conversation can be carried on between New York and Chicago nearly as plainly as it is over the city telephone wires. Yet this is what the Postal Telegraph Company has done. It has also perfected a system of word transmission which, for rapidity, is beyond anything heretofore dreamed of. This success of the Postal Company is merely an advance step in a succession of improvements in telegraphy which have been going on for years under the various private companies. Private companies spurred on by the incentive of competition have thus made advances in the art which are continually tending toward expediting telegraphic word transmission and bringing the usefulness of the business within the reach of more of our people by reducing the rates for messages. If the Government had had control, the only incentive for advance would have been the desire of politicians and their friends to have new-fangled instruments of their own construction substituted for those in use. While this would, of course, invite invention, the invitation would not be as strong as that of a private company. For, even having invented a good thing, it would be impossible for the inventor to have it adopted unless he divided the profits with some government official high in power. The Government, besides, would very likely throw away much money in adopting at the instance of power wielding politicians inventions of no good whatever.—*Pittsburgh Leader.*

An Animated Interrogation Point.

With the exception of names, the following is an exact copy of a letter received by a railroad official in Pennsylvania. As the writer's chirography corresponds with his general "style," we commend him to the Valentine Brothers, about whom he seems anxious:

———, Penna, 3, 21, 83.

Mr. —— ———

DR. SIR: I take the liberty of asking you a few questions about Telegraphy, having obtained your name through the P. M. of W———. Which in your opinion is the best place to learn Telegraphy? An office or Telegraph School? And what are your reasons for your preference? If a school, what one? What do you think of the Western School of Telegraphy conducted by Valentine Brothers, of Janesville, Wis.? If you think an office the best place will you receive me as a pupil? Upon what terms? Have you any students in your office? If you cannot engage to teach me, do you know of any one in W———, or elsewhere, who will? How long will it take to learn in an office? Can you secure me a paying situation when competent? Where did you learn? What are the average wages of an operator? How long will you remain in W———? Please answer the above by return mail and greatly oblige,

Yours respectfully,

—— ——.

P. S. How many telegraph offices are there in W———? How many operators in each? Who are the chief operators? What are the salaries of the different operators in your city? What are the chances of promotion in this State? Are there more operators than positions?

THE OPERATOR
AND
ELECTRICAL WORLD,
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W. J. JOHNSTON, Editor and Publisher.

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NEW ADVERTISEMENTS.

In the growth of our paper in circulation, size and general improvement, the value of its columns for reaching those engaged in electrical pursuits or interested in electrical matters has not failed to be appreciated by advertisers. In order to better enable our readers to notice anything new which advertisers may have to offer them, we now give in this column a list of new advertisements as they appear in each number. The following will be found in to-day's issue:

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UNDERGROUND TELEGRAPHS.

The heroic measures recently adopted by the Mayor of Chicago in throwing down the lines of the Mutual Union Company, and the legislative action pending in other cities to compel the placing of telegraph and telephone wires underground, have caused renewed interest in the subject of subterranean communication. Whatever may be thought of the merits or demerits of such a system, there should be no doubt as to the justice of allowing the various companies ample time to place their wires underground.

The telegraph and telephone have proved themselves indispensable to the needs of commercial and social intercourse, and anything which promotes those ends should be allowed the freest latitude in reaching every point. The exigencies of modern business and social life require not only the widest extension and the cheapest maintenance of electric service attainable, but also its readiest extension. Anything else will only be to limit the usefulness and impede the progress of the greatest and most useful inventions of the age—the telegraph and the telephone. It is now a common thing for business houses to supplement the facilities offered by the telegraph companies and the telephone exchanges by maintaining from one to a dozen or more private lines, and the business public will not willingly assent to any curtailment of such facilities. In the latter case a law compelling all wires to be put underground would be little less than prohibitory. Indeed, in spite of some glaring advertisements, it is not too much to say that there is not now in existence a perfect system of underground communication suitable alike for telegraphic, telephonic and electric lighting purposes.

In any event, a law compelling the existing companies to put their wires underground, within, say, two or three years, would be unreasonable, and it would operate against the welfare of the general public. It would involve the cutting off of three-fourths of the branch telegraph offices, which are now a public necessity, to say nothing of the district and telephone offices, both of which would be practically destroyed. It is certainly unfair to invoke legislation to compel the various companies to accept any one scheme of underground communication, or even to bury their wires before they were quite ready to do so.

Many electrical engineers give it as their opinion that while overhead wires, when strongly built, are generally best for all working purposes, they are more expensive in the long run. Thus it would appear that the interest of the companies lies in burying their wires, and when the proper methods shall be presented the question of subterranean telegraphy will solve itself.

As previously noted in these columns, a Wheatstone automatic telegraph department has recently been introduced into the operating room of the Western Union building, in this city. This is the system used by the British Postal Telegraph for fast work. It having been stated that the introduction of this system was looked upon with misgivings by the Morse operators in the United States, a representative of THE OPERATOR AND ELECTRICAL WORLD called upon several operators employed by the Western Union Company, in this city, to obtain their views on this subject. They stated in substance as follows: "There is no doubt we were somewhat alarmed at first by the introduction of the Wheatstone system, as we feared an importation of cheap labor, nearly all the present Wheatstone staff being ex-employés of the British Postal Telegraph service; but unless the system does much better work hereafter than it has done during the past month, we do not think it need be regarded as a very strong rival. At present there is but one Wheatstone circuit in operation, that one between New York and Chicago, and it has not been worked regularly, so that we have not much data to draw conclusions from. Thus far, however, but two operators here and two in Chicago have been withdrawn from the Morse circuits on account of the business taken by the Wheatstone department, while there is a force of 18 employés in New York, and one of 22 employés in Chicago to do the work so taken. This is perhaps an argument in favor of the Morse system. We also think the same trouble will be experienced with the Wheatstone system as has been met with in other automatic systems, namely, a greater liability to errors and also greater delay in the delivery of messages." Our representative next talked with one of the gentlemen connected with the Wheatstone system here. He stated that up to the present time the Wheatstone system has not had an entirely satisfactory trial in this country, the storms in the West during the early part of last month having interfered to a great extent with the tests. "Apart from this," he added, "our staff is out of practice, and therefore unable to do the work as promptly and thoroughly as is customary." He thought that any fears in the minds of Morse operators with regard to their displacement by the Wheatstone system were groundless. The main object of the introduction of this system is, he said, to increase the capacity of the existing wires, not to reduce the number of employés or their salaries. For instance, it is not possible to transmit by the Morse system on an average more than, say, 1,900 words over a single wire in a day of nine hours, while by the Wheatstone system 110,000 words may be sent during the same time on the same wire. Of course, the preparation of this amount of business for transmission and its transcription when received will require at least as large a working staff as would be necessary to transmit and receive the same number of words over half a dozen single wires by the Morse system. But, apart from this, the Wheatstone is not desirable, except between large cities, where much business is to be handled. It can never take the place of the Morse system on way circuits. In England the system is used principally for press reports. If the Wheatstone should prove satisfactory between New York and Chicago, it will very likely be extended to other points. The above shows that the automatic system can never be a very formidable rival to the old, original and reliable Morse. We have frequently heard anxiety expressed upon this score, but we have always held that against any automatic system the Morse will hold its own in the long run.

MR. EDMUND YATES is quoted as saying that the age we live in is one of criticism rather than of construction. This is no doubt true within certain limitations, but, like most generalizations, it errs in covering too much. In matters of speculation and of authority the attitude of the age is undeniably one of criticism. There is no doctrine too time-honored or too widely accepted to be safe from the rude shocks of the spirit of inquiry that walks the earth at the present time. But side by side and co-extensive with this feature of modern intellectual life, there is a constructive spirit whose existence cannot be ignored, and whose work is nowhere more apparent than in the natural sciences. The spirit of inquiry is sweeping away old scientific theories and alleged facts and deductions, but at the same time it is building up, block by block, a substantial and durable structure, whose growth is so rapid that constant attention is required to keep up with it. Hence, one of its signs is the demand for scientific literature, and the remarkable increase in the number and circulation of journals devoted to special branches of science, and to trades and callings based on science. Every intelligent craftsman knows that in order to be successful in his art he must keep himself informed of what others are doing in it. Fortunately this can now be readily done in most cases. A prominent newsdealer in a Western city recently remarked: "The trade and class journals are steadily increasing in number and improving in quality. It is a poor trade or calling which has not its weekly or monthly organ, and many of them are equal or perhaps superior to the oldest and best publications of the kind in Europe. Our mechanics and workingmen are great readers, and visit us weekly for their favorite journals. These latter discuss intelligently all new ideas and inventions pertaining to the branch of trade represented, and are of immense benefit to their readers. This class of men used to indulge in less useful and instructive reading matter, when they read at all, but they now give the trashy papers the 'go-by.'"

THE remarkable progress and financial success of the Bell telephone, the recent striking developments in long distance telephony, and the halo of romance that, in spite of familiarity, still clings to the act of conversation, face to face, as it were, between persons miles apart, have all combined to produce in the public mind a state of credulity with respect to the telephone that is often amusing enough. No fable concerning the telephone is too gross to receive credence; no prediction of its future can be wild enough to provoke a smile. The daily papers—and some others that ought to know better—gravely circulate, without criticism, the most absurd tales of wonderful new telephonic inventions and marvelous feats of telephony. As a natural consequence of this state of the public mind, new telephone companies are springing up in every direction, based upon hitherto unheard of inventions, issuing the most glowing prospectuses, and each and all threatening the Bell monopoly with demolition. Notwithstanding the recent sweeping decision in the Bell-Dolbear suit, which might have been expected to cast a damper upon "opposition" telephone enterprises, it appears as if any telephonic scheme can readily find support. It is probable that in many cases investors in these schemes will acquire a considerably greater knowledge of electricity and acoustics before they are done than they possess at present. There is undoubtedly ample room for the remunerative investment of capital in the development of the telephone, but those who are thinking of taking part in it would do well to seek the advice of competent and trustworthy experts, before embarking their means in the development of alleged new devices which have not yet passed beyond a local test, the Patent Office *Gazette*, or the pages of a prospectus.

A CURIOUS monopoly has come to light in Pittsburgh. The city having advertised for proposals to light the wharf by electricity, but one bid was received, and the contract was accordingly awarded to the Allegheny County Electric Light Company, the price being $4,000 per year for twenty lights. It was subsequently learned that New Orleans pays but $3,000 for thirty lights. An investigation ensued, and it was discovered that the Allegheny County Company, under an old law, created before electric light companies existed, has a perpetual immunity against competition, and can therefore fix its prices at its own sweet will. The law in question says that "companies incorporated under the provisions of this statute for the supply of water to the public, or for the manufacture and supply of gas, or the supply of light or heat to the public by any other means," shall have the exclusive right to the franchises and privileges of such incorporation until it shall have earned and divided, during five years, a dividend equal to 8 per cent. per annum upon its capital stock. Of course it is easy to keep the dividends down to 7½ per cent., and the balance of the earnings could be used for increasing the wealth of the concern. This in time would become so powerful that when the company did declare an 8 per cent. dividend it would be useless for any other concern to compete with it. This incident suggests the importance of a revision of our statutes to cause them to conform to the altered conditions which electricity is producing in modern life, a subject which has already received considerable attention in England.

THE astonishing increase in the telegraph business during the past seven years is strikingly illustrated in our article, published to-day, descriptive of the Western Union main office in this city. Erected only eight years ago in the belief that it would be large enough to accommodate the business for twenty years to come, with only about half of its available space then occupied, it is surprising to reflect that in that short space of time it has been overcrowded, and that it is no longer adequate to the business. The use of the telegraph for social and business purposes and for the dissemination of news over vast distances is increasing steadily every year, and in ten years more we shall not be surprised to see the present volume of business doubled. Good management and competent workmen have done more than anything else to bring about this great popularity of the telegraph.

IT is being remarked that, with the wider field and steady growth of electrical science, the telegraph operator of to-day has a far better opportunity of pushing himself forward than he had a few years ago. Indeed, many of

them have attained distinction and wealth, but it has been mainly by extensive reading and study. In this view of the matter THE OPERATOR AND ELECTRICAL WORLD has been unremitting in its efforts to aid those who are ambitious to succeed. Those who would succeed must be posted upon all subjects connected with electrical working, and such information can be found in its widest scope in the columns of THE ELECTRICAL WORLD.

THE launching of Mr. Jay Gould's new yacht at Philadelphia, on Saturday last, created quite a stir in that staid old city. The Gould family may safely say "Our saucy ship's a beauty," and we wish her good luck from stem to stern, port and starboard, and from maintop royals to keel. But a lover of gold, such as Mr. Gould is reputed to be, should hardly have chosen the name "Atalanta" to bear him across the raging main; for, although Atalanta outran all her lovers, she was beaten ultimately by Hippomenes, who threw down the *golden* apples given him by Venus; while in tarrying long enough to pick them up the avaricious Atalanta lost the race.

AN objectionable feature of the elec tric arc light, which will no doubt be overcome in time, is the hissing or frying noise which accompanies the passage of the current between the carbons. At a musical festival in Pittsburgh, a few days ago, the experiment was made of lighting the stage by electricity, but the electric lamp persisted in mingling its note with those of Nilsson, to the very evident annoyance of the prima donna, who frequently cast reproachful glances at her audacious rival.

THE decision of Judge Arnoux, restraining the Western Union from paying dividends on its stock issued to purchase the American Union lines, and from which decission the company appealed, has been affirmed by the Supreme Court. Mr. Gould, however, announces that he has arranged with the Mercantile Trust Company to advance to all stockholders of the Western Union on and after April 12, 1883, the amount of their dividends payable April 16, 1883. The portion of the January dividend still unpaid will be arranged in the same manner. Meetings of the Mutual Union and Western Union stockholders will be held in this city on the 18th and 19th inst., respectively, the object being to formally confirm the lease of the Mutual Union to the Western Union, and thereby remove the legal objection expressed in Judge Freedman's recent decision.

A DECISION of importance to telegraph, telephone and electric light companies was rendered at Hartford, Conn., on April 11. A Mr. Robinson of that city gave the Southern New England Telephone Company permission to temporarily place wires on his block of buildings in Hartford. The company, not being in a hurry to remove them, Mr. Robinson, after notifying the company that he would do so, had the wires cut. A suit was brought by the company for $3,000 damages. The trial took place on April 11 before Judge Andrews and a jury. The judge charged strongly in favor of Robinson, and impressed upon the jury the fact, that the owner of a building exercised the exclusive control of every part of it from cellar to roof. The jury, after an absence of twenty minutes, brought in a verdict for the defendant, with costs.

A CORRESPONDENT in Texarkana, Ark., asks us to republish the poem by Mr. H. H. Johnson called "The Night Telegraph Operator," which originally appeared in our issue of January 1, 1882. He thinks it is "a beautiful recitation of a night man's experience." Another correspondent requests the republication of "King Richard's Barbecue," a poem of great merit, by Mr. Thomas C. Noble, Jr., which first appeared in our March 1, 1880, number. These correspondents, whom we thank for their suggestions, say that with the increased circulation of the paper these poems will be new to many readers, and anyway are good enough to bear re-reading, even by those who have seen them before. We accommodate our second correspondent to-day, and may similarly gratify our Arkansas friend in a future issue.

THE proprietor of a telegraph school in Boston was last week forced by a detective to return $30, paid him by a young lady to teach her telegraphy. She says that after she paid him the money he kept her and several other victims sitting around doing nothing, and then told her to leave. She asked for the return of her money, but the professor laughed and asserted that he was too sharp to be caught in the meshes of the law. He, however, was afterward glad to hand over the amount to the detective. It is said that the police have other complaints against the same concern, which we commend to the attention of the Brotherhood in Boston.

A TELEGRAM from Boston says that the Western Union messengers of that city, having been told that on and after April 9 they would be paid only 2 cents for the delivery of each message and nothing for answers, instead of 2½ cents in each case, held a meeting and unanimously voted not to deliver a dispatch for less than 2½ cents. If the reduction were persisted in, a general strike of the boys was threatened. Up to the time of going to press we had heard nothing further in reference to the strike, and presume that the pittance paid the little fellows was not cut down.

SINCE it was announced that Chicago had conversed with New York by telephone, every village in the Northwest that has attained the dignity of a telephone is expecting to shortly be able to hold converse with the metropolis.

TO Dr. Norvin Green, who sailed on the Alaska for Liverpool on Tuesday last, we wish a speedy voyage and a safe return. Dr. Green has well earned a holiday, and he could not have left the affairs of the Western Union in better shape.

THE unveiling of a statue to Professor Henry will take place in Washington on Thursday next, and will be a fitting tribute to the great searcher after truth.

On a Simple Formula for Determining the Insulation of a Section of Wire, Measured through an Intermediate Lead.*

BY G. A. HAMILTON.

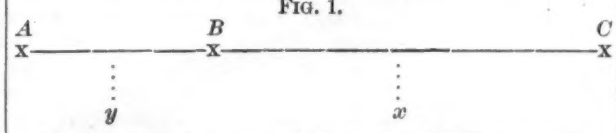
It frequently happens that when the insulation resistance of a section of line or an underground wire or cable is wanted, various impediments prevent reliable measurements from being made at either terminal of the same.

At a cable house it may be the wind or the jar resulting from passing trains along a railroad, the bumping of a ferry-boat against the dock, or the inductive disturbance due to the motion of its machinery; or, again, it may be the constant passing of trains along the elevated road that interferes. In some of the cases enumerated it is undoubtedly possible to obtain correct measurements if time is a matter of no consequence, but when it is an important factor the delays and incident annoyances make the measurement of 10, 20, or more conductors anything but a pleasant occupation.

Having experienced all these troubles in and around New York, the writer has made it a practice, in all cases where approximate accuracy is desired, to adopt the old plan of measuring the insulation through a lead of such length as convenience or the circumstances of the case will permit and, at the same time, allow of placing the galvanometer where its indications may be depended upon. The resistance sought is then deduced from the combined results obtained.

As he does not remember of having seen the formula he used outside of his own memoranda, and thinking it may prove interesting to some of the members, he is induced to give its full development herewith:

FIG. 1.



Let $A\,B$ (Fig. 1), represent the lead and $B\,C$ the conductor whose insulation resistance is sought, the conductor resistance in each case being a *small fraction* of the insulation resistance, which latter may be represented by y and x respectively.

Under these circumstances, with $A\,B$ and $B\,C$ joined and the end at C insulated, measurements made at A will give the joint insulation of the two conductors, which we will designate by z.

Then $z = \frac{x\,y}{x+y}$ and the insulation sought will consequently be

$$x = \frac{y\,z}{y-z} \qquad (1)$$

As x, y and z are usually high, measurements by the bridge method are not often practicable, and a mirror or other galvanometer, whose deflections are proportional to the current circulating in its coils, is then generally employed. When this is the case the constant of the instrument must be known. This is obtained in the well-known manner by ascertaining what deflection it gives through a known resistance with a given battery. The resistance sought is then found by placing the same instrument and battery in circuit with it, noting the corresponding deflection and dividing the constant previously obtained by the latter deflection. The quotient is the resistance sought in ohms or megohms, as the case may be.

In using this method for determining the insulation of a section of line through a lead many persons would naturally take the round-about way of finding the resistance of the lead and joint resistance of lead and section tested, separately, and then combine the results as in formula 1. If, however, the combination is first effected, the resulting formula gives the required insulation with very little calculation. This is the plan the writer finds most convenient to practice:

Let A represent the constant of the instrument, *i. e.*, the resistance through which, with a given battery, it will give one degree deflection;

d, the deflection obtained when the lead, instrument and battery are in circuit;

D, the deflection when the lead, instrument, battery and section whose insulation is wanted are in circuit.

The insulation of the lead would then be

$$y = \frac{A}{d} \text{ or, if reverse currents are used, as is proper,}$$

$$y = \frac{A}{\frac{\Sigma \pm d^s}{2}} \qquad (2)$$

where Σ is a symbol only, and indicates that the sum of the + and − deflections are to be taken.

*Paper read before the New York Electrical Society, April 6.

The joint insulation of lead and section would, in like manner, be

$$z = \frac{A}{\frac{\Sigma \pm D^s}{2}} \qquad (3)$$

Substituting these values in equation (1), we have:

$$x = \frac{\frac{A}{\frac{\Sigma \pm d^s}{2}} \times \frac{A}{\frac{\Sigma \pm D^s}{2}}}{\frac{A}{\frac{\Sigma \pm d^s}{2}} - \frac{A}{\frac{\Sigma \pm D^s}{2}}} = \frac{\frac{4A^2}{\Sigma (\pm d^s \times \pm D)^s}}{\frac{2A}{\Sigma \pm d^s} - \frac{2A}{\Sigma \pm D^s}} \qquad (4)$$

Dividing by $2A$ and multiplying — (both numerator and denominator) by $\Sigma (\pm d \times \pm D)$, the resulting equation takes the form

$$x = \frac{\frac{2A\Sigma(\pm d^s \times \pm D^s)}{\Sigma(\pm d^s \times \pm D)}}{\Sigma\left\{\left(\frac{\pm d_s \times \pm D^s}{\pm d^s}\right) - \left(\frac{\pm d^s \times \pm D_s}{\pm D^s}\right)\right\}}$$

which on cancellation of common factors becomes

$$x = \frac{2A}{\Sigma(\pm D^s - \pm d^s)} \qquad (5)$$

the most convenient form for use.

In the foregoing illustration a single + and — reading only are taken; if more are used the same should properly appear in the formula, and it is, of course, necessary that a like number of readings should be taken for the lead (whether they do or do not vary) as is taken in the joint measurements.

It will also be understood that when shunts are used they should be accounted for in the formula, as, for instance,

$$x = \frac{2A}{\Sigma \pm (D^s \times \text{shunt} - \pm d^s \times \text{shunt})}$$

This is supposed to have been done for A at first.

A Lineman's Poetical Report and its History.

To the Editor of The Operator and Electrical World:

SIR: By request, I send you the following poetical lineman's report, written by E. Dorsey Eve, who was an operator here for the Magnetic Telegraph Company some years ago. Many requests have been made for this "Poetical Report." Through the kindness of Mr. F. M. Aldridge, editor of the *News* of this place, we have at last obtained a copy of this relic of by-gone days, and it will no doubt be interesting to many:

James R. McDowell, Supt.

DR. SIR:

I started out on yesterday,
And got a mile upon the way;
I found three posts completely down—
The glasses from the brackets thrown,
The wire broken twice or thrice,
And nought had I wherewith to splice
The same, else had I sooner come
To greet my little ones at home.

Oh, "Home, sweet Home"! there is no place
On earth's broad bounds where I can trace
A dearer, brighter, heavenlier spot,
Than where my good wife boils the pot.
But to proceed about the line——

I spliced it with a bit of twine,
But when to test I tried to work it,
I found I did not have a circuit.
I then returned to "F R" station,
In a state of mental desperation,
Procured the wire I wanted,
And on my outward journey jaunted.
After dint of much vexation;
And copious streams of perspiration,
The whole affair, dear sir, was done,
And I returned to-day at one.

Respectfully yours, J. W. CREIGHTON.

This report was soon after sent to the Hon. Amos Kendall, then president of the company, by Supt. McDowell. Mr. Creighton received a telegram from Mr. Kendall as follows:

J. W. CREIGHTON, F. R.: You will in future send all communications to this department in prose.

A. KENDALL, Pres't.

Mr. Eve, the operator in charge of the office, not desirous of being known as the composer of the report, sent the following in reply to the above:

HON. A. KENDALL, Pres't, Washington, D. C.: The report forwarded you by Mr. McDowell was not written by Mr. Creighton. It was the work of a mischievous young man in this office. EDWIN D. EVE, Operator.

Mr. Kendall soon after found out the joke, and enjoyed it very much. This report was, I believe, posted in every office in McDowell's division at that time. Mr. Eve is now superintendent of the telephone exchange in Cumberland, Md., in which city he was for many years engaged in editing a daily paper. He is one of the old timers, and any of the boys who should happen to meet him in their wanderings, will find him with a large stock of wit and humor on hand. D. U. PLEX.

FREDERICKSBURG, Va., April 24, 1883.

Five Railroad Questions Asked and Answered.

To the Editor of The Operator and Electrical World:

SIR: You will readily perceive from the date of this communication that I am one of those beings whose lot it is to reverse the natural system of diurnal and nocturnal labor and rest. I have just come on duty for the night, and as work is very light until ten o'clock I shall soon light my "pure havana," get your interesting paper, take my easy chair and, elevating my pedestals (No. 10s), will be a complete picture of solitary happiness.

Before I enter into this delicious reverie, I shall drop you a few lines, which I hope you will give admission to the columns of THE OPERATOR AND ELECTRICAL WORLD. The following is embodied principally in five questions, which I beg you to insert in order that I may soon hope for answers to them from some of 'the boys' who, per-

haps, have had more experience at railroading than I have.

First—How long will some railroad officials give favoritism preference over merit?

Second—How long—this being the case—should they reasonably expect their business to be successfully managed and conducted in a manner satisfactory to their patrons?

Third—How long before an operator may expect promotion when he sees new men of undoubted inferior ability appointed to positions far better and more remunerative than the position which he has satisfactorily filled for some time?

Fourth—How long, or how far in the line of promotion, should Mr. A. stand ahead of Mr. B. when Mr. A. is an ex-employé, not having been engaged in the service of the company for several years past, and Mr. B. is a regular employé *(id tem)*?

Fifth—How long will it be before an operator intrusted with the handling of train orders is likely to be the cause of a collision of trains when he 'bulls' four out of nine simple words in one message?

An instance which has recently come under my personal observation has been suggestive to me of the above questions, and I would be very glad to hear from you and some of the 'boys' in reference to them, and see how much your ideas differ from mine, which I append as follows:

First—Always, it seems.

Second—Five minutes—Not more.

Third—999 years, more or less.

Fourth—A long way—If "backing" up the line.

Fifth—Depends upon how soon he receives his next train order.

The "bulling" case to which I refer I will cite, and ask your readers if it does not beat anything on record to date: The message read (as sent): "Express wagon failed to call; will ship machines to-morrow." And as received by the blunderer: "Expected word, but failed; will ship machines to-morrow."

If no instance can be produced to compete with this, we shall inevitably decide that this case takes the cake.

OWL'S SANCTUM, Ohio, March 3d. 1883. ROVER.

Pittsburgh Personals.

To the Editor of The Operator and Electrical World:

SIR: Mr. Edward Corrigan, of the Western Union office in Allegheny, Pa., died in that city on April 5, of consumption. He had been in the service of the company for seventeen years. It will be remembered that the striking operators at Denver, last year, asserted that Mr. Corrigan had been ill-treated when he went to that city in search of health, but he himself declared the allegation to be unfounded. He was highly esteemed by his associates, who contributed generously toward his relief during his long illness. He was a member of the T. M. B. A.

A ripple of excitement was caused in the Western Union main office the other day by a blaze suddenly springing up among the covered wires near the switch-board. A fire extinguisher which had adorned the office for a number of years without being called upon, except when some rural visitor tried to get a drink out of it, was brought into requisition and the flames were extinguished. As usual in such cases, electric light wires are charged with having caused the damage.

Gilhooley's Etchings, an alleged humorous journal of this city, in a column headed "Our Telegraphers," in its issue of April 7, touches up our local telegraphic celebrities as follows. It is to be hoped that the perpetrator, who is evidently one of the craft, will be discovered and receive the punishment he deserves:

"Jack Garrett, of the Rapid, stands high as a vocalist. The B. & O. boys are proud of their new quarters. George Stewart, of Allegheny, is a great ladies' man. Jimmy Fisher, light-weight, is regaining his appetite. Charley Stough is writing up his reminiscences of the flood. Billy Maize may go out with a circus this summer as a giant. Hankus Burrell smiles just as sweetly as he did in days of old. Colonel John Byrnes, the sanguine man, now toils for the American Rapid. Tom Hunter is known as the cigarette fiend. Tom is a fine operator. The Brotherhood of Telegraphers continues on the booming road to prosperity. Handsome Jersey Hill is happy in anticipation of the approaching ice cream season. Beauty Smith, whose front handle is Luther, has some idea of going on the stage. Pete McKeever, who has been laid up with typhoid fever, is in the front rank again. Phila. S. Dilworth, one of the 'intellectuals' is revising his lecture on temperance. Captain John Ryan, who has been ill with the influenza for several days, is on deck again. Tom Egan is hard at work on a treatise on the influence of Christianity upon civilization. Dode Mooreland, one of the old landmarks, still deals out lightning with deft fingers. Jim Golden is the inventor of a patent double acting spring back sausage machine. Charley Craig, leading man of the Charlotte Thompson Company, is an old-time telegrapher. Jack McKenna is one of the heaviest men in the W. U. He is known as the 'skeleton witness,' John Aughenbaugh was anxious to encounter the Maori, but could not arrange matters satisfactorily. Mel. Munson, one of the W. U. traffic chiefs, has entered the lists for the heavy weight championship. Charley Adams, late manager of the Mutual Union goes on the *Dispatch* as superintendent of circulation. 'Tip' McClarkey has been out in the country farming. He turns up in good shape and is posted on the crops. George Morse, formerly of the Western Union, this city, but now of Hot Springs, is talking about coming back. Ellis Rhiveis, traffic chief of the American Rapid, is becoming quite thin in consequence of his arduous duties. Henry Thompson and Reese Lloyd share the honors of the title of professional beauties of the fraternity hereabouts. Frenchy Johnson, manager of the American Rapid 'Ox' office, is a good telegrapher, and a great favorite with the ladies. In the spring a deeper crimson comes upon old Red Cloud's nose. In the spring the festive jagger gets himself a suit of clothes. Billy Welsh, an old Pittsburgh boy, has come back to his birthplace from Chicago and burns the midnight 'ile' for the Mutual Union. Willie Case has been appointed manager of the Oil Exchange Western Union office. Will is a good man, telegraphically and otherwise. James B. Coulter, familiarly known as 'Jimmy the Kid,' was in town last week. Jim is an ideal operator. He is en route from Oil City to Chicago. George Eitemiller, night manager of the W. U. Telegraph, is just as good at handling the key as of yore. He is the fastest sender on this mundane sphere."

Mr. Alf. Askin, the veteran operator in the Western Union office at the Union depot has returned to duty after a six weeks' siege of rheumatism. VOLT.

DEPARTMENT OF INQUIRIES.

As we frequently receive inquiries for information in regard to electrical science and its practical application, we have concluded to add to the departments of THE OPERATOR AND ELECTRICAL WORLD one exclusively devoted to answering inquiries, even such as are only remotely connected with electricity. Such department will serve a double purpose; first, the answers will give the desired information to correspondents; secondly, the nature of the questions may frequently be an indication of the intellectual need of our readers, and show what special subjects would be most acceptable; consequently the department may be of mutual benefit.

6. INCANDESCENT LIGHT BY A GALVANIC BATTERY.

How strong a current would be necessary to light a single Edison incandescent light, or how many cells of gravity battery to do same work?

W. F. H., Newton, Mass.

In order to make a single incandescent Edison lamp glow satisfactorily, it takes from about 50 to 100 Daniel elements. A smaller number has not intensity enough. They will keep it up for one evening, but the next day you will have to clean and renew your battery. You can do it also with a large number of Leclanché elements, but the light will only last about ten minutes; then you would require to disconnect and give the battery rest. After twenty or thirty minutes you can repeat. It has been tried to use three Leclanché batteries in rotation, but such experiments are always given up, owing to the unsatisfactory nature of the results obtained and the great expense.

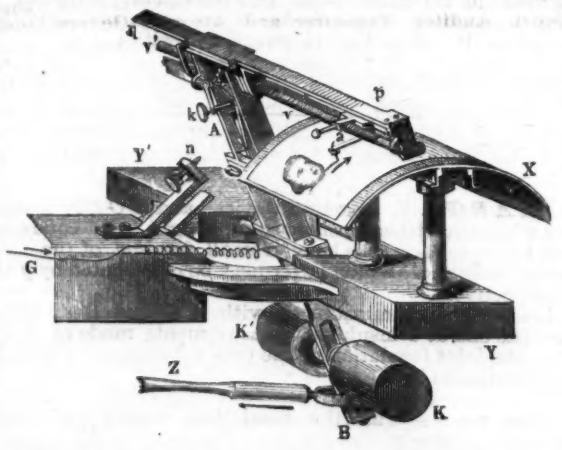
It should not be forgotten that Humphrey Davy, who introduced in 1822 the first electric light in this way with batteries, gave it up for precisely the above reason.

7. TRANSMITTING HANDWRITING BY TELEGRAPH.

Will you please inform me where I can find an accurate description of the method of sending telegraphically written matter, just as written, *i. e.*, of reproducing the original message at a distant station. I have read about the system, but have forgotten even whose invention it is.

H. C. B., Meadville, Pa.

The system by which this is made possible is the Pantelegraph of Caselli, and it is based on the chemical principle, first applied in 1826 by Harrison Gray Dyar, of New York, and subsequently by Baine in his electro-chemical telegraph, which was in use in some of the offices in New York thirty years ago. The same principle is now applied in another way by the Rapid Telegraph companies. In all cases the dispatch is received on chemically prepared



paper discolored by the current. At the transmitting station a conducting point is moved over the drawing or handwriting which is made with a non-conducting ink on conducting paper—and the current is interrupted every time the point touches the ink. At the receiving station another conductive point moves simultaneously over the chemical paper, and draws, like the other point, a series of parallel lines close together; the ensemble of which will ultimately show a copy of the handwriting or drawing by the discoloration of the lines. We subjoin an illustration of the receiving instrument for the benefit of our correspondent, or of others who may become interested in the subject.

8. HOW TO MAKE A CHEAP MECHANICAL TELEPHONE.

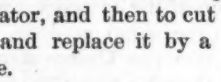
One of my little boys read the following in a local paper:

To make a good and serviceable telephone, from one farm-house to another, only requires enough wire and two cigar boxes. First, select your boxes and make a hole about half an inch in diameter in the centre of the bottom of each, and then place one in each end of the houses you wish to connect. Then get five pounds of common iron stove-pipe wire, make a loop at one end and put it through the hole in your cigar box and fasten it with a nail; then draw it taut to the other box, supporting it when necessary with a stout cord. You can easily run your line into the house by boring a hole through the glass. Support your boxes with slats nailed across the window, and your telephone is complete. The writer has one that is 200 yards long and cost 45 cents, that will carry music when the organ is played 30 feet away in another room.

He constructed one as per instructions, but it was an utter failure. I told him I would write you, and perhaps we could ascertain how properly to construct one. The boy feels downcast over his unsuccessful experiment, and I am anxious to get information for him that he may have the satisfaction which always goes with success.

G. A. K., Binghampton, N. Y.

We have seen the above item, and don't wonder at the failure, as the description is exceedingly incomplete. The important matter that the wire must be stretched very taut is omitted; also that it must not touch anything solid, but must only be supported in as few places as possible by strings. The only solid bodies the wire must touch are the cigar boxes at its extremities. The hole through which it passes must be in the middle of the bottom of the box,



and the nail close to the hole, so that the pull of the wire takes place at the middle portion only. This will secure the principal condition, that any sonorous vibration in the bottom of one box will by the stretched wire be transmitted to the bottom of the other box and so become audible there. Our simple figure illustrates the wire and the two boxes. If the latter have to be attached to anything it must be by their edges, so as to leave the bottoms free for vibration. These are known as tension telephones to distinguish them from the ordinary electric telephones.

9. REPAIR OF WIRES BROKEN CLOSE TO GLASS INSULATOR.

Suppose the wire on a pole line is broken close to the glass insulator, what is the best way to repair it, without losing slack wire? It is understood, of course, that a strap and vise are to be used. Please describe the operation in detail, in order to settle a dispute.

"235," New York City.

A man whose experience in building and repairing telegraph lines extends over ten years gives his opinion, as follows: The first step is to fasten one end to the insulator. Usually one end remains fastened to the insulator, but in many cases the "tie" wire is twisted around and loosened, and a new one should be used. Then cut off a short piece of the broken or fallen section and splice it with a longer piece; fasten the vise near this joint and tighten the wire with the strap. Now pass this short end of the wire to the other section, beyond the insulator, and twist it around this wire so as to make a half joint; cut the tie wire holding this section tight, and this gives a free end that may be twisted around the end of the spliced portion, and thus completes the joint. In this way no slack is lost on either side of the pole, and the amount of tension or pull is equally distributed on either side of the pole. The only step remaining is to secure the wire to the insulator by means of a new tie wire. The theory of the operation is simply this: To lengthen the loose or fallen end of the wire and fasten it, after stretching, to the other end beyond the insulator, and then to cut out the connection to the insulator and replace it by a new one, after the splice is complete.

10. SHOCK FROM SWITCH-BOARD.

Why is it that a person receives no shock from the switch-board or "cut-out" when some other office is working, while as soon as the key in his own office is opened he receives a most decided shock?

"CU," Germantown, Col.

Because when the key or switch in his own office is closed the metallic circuit is complete and the current will follow that, but when he opens his own key or switch his body may, by contact, be made to become part of the circuit, and then it will, of course, pass through his body.

11. TELEPHONING AT GREAT DISTANCES.

In the New York *Witness* of March 15, I see an account of a conversation by telephone 3,500 miles. I can hardly take it in until I see an account of it in THE OPERATOR AND ELECTRICAL WORLD. We are all interested, or should be, in telephone or telegraph improvements, and if it is possible to talk 3,500 miles we want to keep up with the times and know all about it. J. B. R., Hobart, N. Y.

If the account means that experimenters succeeded in holding a conversation by telephone through a resistance of 50,000 ohms, which is about equivalent to 3,500 miles of ordinary telegraph wire, we believe it, because we have accomplished similar feats ourselves. The resistance, however, on that occasion consisted of a number of insulated wire coils, all placed in the same building, and the experiments turned out quite differently when the resistance consisted of telegraph wires suspended on poles in the open air. In the latter case it was more difficult to converse through 500 ohms' resistance, than through 50,000 ohms in the form of coils in a house. The most reliable accounts of long-distance telephoning are those given in the issues of THE OPERATOR AND ELECTRICAL WORLD for March 17 and 31, where it is stated that successful telephonic communications were held over a distance of 700 miles, between New York City and Cleveland, O., and also between New York City and Chicago, 1,000 miles. Several different transmitters were used, among others one constructed on the Baxter principle, improved by Hopkins, which operates by a piece of carbon floating on mercury, which secures an always equally adjusted contact. Papers like the *Witness* are very much inclined to publish sensational accounts for which there is not enough foundation to make them even probable. Therefore you are perfectly right not to "take it in."

12. CALLAUD BATTERY.

To what extent does the temperature affect this battery, and how, for instance, would a variation from 50° to 70° act, and what is the action that takes place in the cells in consequence of the variation of temperature?

FELIX, Toronto, Ont.

Callaud's battery is in this respect not different from any other, as a moderate rise of temperature will increase chemical activity, and as this is the cause of the electric current, it will also increase the current. The chemical action in the cells will be just the same, namely: Oxidation of zinc, formation of sulphate of zinc and the precipitation of metallic copper. The operation, however, will go on faster and the battery will be sooner used up. A certain amount of zinc consumed gives a certain amount

of current, which you may use up in a week or in three days, acoording to temperature, and, of course, also according to the amount of current you cause to be discharged, whether the circuit is short or long.

Fs., Ashford, N. Y.—Mr. W. P. Phillips, United Press Association, 135 Broadway, New York, will give you the information in reference to his pamphlet on stenotelegraphy.

THE ELECTRIC LIGHT.

BRUSH *vs.* VAN DE POELE.—In the United States Court at Chicago, on April 5, Mr. Charles T. Brush and others filed bills against the Van de Poele Electric Light Company and J. Irving Pearce to restrain them from using the Brush patents, issued October 23, 1877, for improved metal-plated carbons.

THE MAXIM COMPANY IN PHILADELPHIA.—At Philadelphia, on the 28th ult., Judge Allison granted a temporary injunction restraining the Maxim Electric Light and Power Company from erecting poles and operating wires on the west side of Delaware avenue, between Vine and South streets.

PORTLAND, OREGON.—The Brush Company offers to illuminate Portland with electric lights for $26,000 a year. The city is sure to accept. The tower system, so satisfactory to San Jose and Los Angeles, is proposed for Portland. Twenty tall towers, well distributed, will brilliantly illuminate every street and every nook and crook. Two hundred thousand candle power expresses the total consumption of electricity.

THE ELECTRIC LIGHT IN SWITZERLAND.—A scheme has been proposed for lighting the entire Swiss Canton of Vaud by electricity. The motive force would be derived from turbines of 5,000 horse-power; and, the water supply being constant and abundant, the projectors have good reason for believing that gas, which is very expensive in Switzerland, may be almost entirely superseded throughout the district.

NEW COMPANIES.—The following new companies were licensed, incorporated or organized last week: The McTighe Electric Light & Manufacturing Co., of Pittsburgh, Pa., capital, $300,000; the Garden City Electric Light Co., of Chicago, capital, $1,000,000; the Chicago Electric Light & Power Co., capital, $1,000,000; the Galesburg (Ill.) Edison Light Association, capital, $25,000; and the Indianapolis (Ind.) Parker Electric Light Co., capital, $100,000.

THE EDISON LIGHT IN THE HOUSE OF COMMONS.—It is stated on good authority, says the *Engineer* (London), that to work the Edison electric plant for the lighting of the corridors of the House of Commons an American steam engine is to be employed. This journal hopes that when the engine does get into the House of Commons it will answer its purpose better than some of those brought over to that country for the same purpose have done.

ELECTRIC LIGHTING FROM A BATTERY.—Mr. Chancey W. Mead, a telegraph operator of Indianapolis, claims to have invented an electric lamp which far excels all others in economy. He says: "With a battery of forty cells and one carbon to a light I can produce twenty lights of 320 candle power, and the cost for the material for the lights for three months will be only five and a half cents apiece, or if ten lights are used with such a battery the cost will be only eleven cents a light for three months. That is, I mean at retail prices you can buy chemicals enough to supply the battery for three months at a cost not exceeding $1.10. That battery can be made to produce twenty lights, but to be on the safe side I will make the estimate on only half that number, and even then the cost will be only eleven cents a light for three months." Before accepting this statement we will wait for further details, which are promised in a few days, when an exhibition of the light is to be given. Mr. Mead says: "I was told by the Patent Office that it was contrary to the principles of science to suppose that light could be produced by means of an electric battery, but here it is."

TELEPHONE DEPARTMENT.

ADVICE.—Never turn a deaf ear to the telephone.—*N. Y. Commercial Advertiser.*

THE TELEPHONE IN PENNSYLVANIA.—A large force of workmen are engaged upon the new telephone line between Danville and Milton, Penna. The wires are up within a mile and a half of the town. As soon as the line is completed Danville will have telephone connection with Williamsport and Lock Haven.

A NEW COMPANY IN KANSAS.—At Kansas City the United Telephone Company was incorporated last week with a capital of $700,000, and headquarters in that city. The company has purchased the property of the Merchants' Telephone Company of Missouri and Kansas. The incorporators are E. T. Gilliland, Indiana; George L. Beetle, Chicago; and Kansas City parties.

THE GLOBE TELEPHONE CO.—Papers were filed at Albany, on the 4th inst., organizing the Globe Telephone Company, with a capital of $10,000,000, for doing a telephone business throughout the United States. The purpose is said to be to use instruments that will overcome all the present obstacles and talk over the longest distances.

LONG-RANGE TELEPHONY OBJECTED TO.—This thing of long-range telephoning must be stopped. It's bad enough to be frenzied and tempted to profanity by yells for a man four squares away, without the prospect staring one in the face, of calling up Cleveland or Halifax or Kamschatka, and waiting till you get them.—*Pittsburgh Telegraph.*

TROUBLE FOR MEXICO.—There is a world of suffering in store for the Mexicans. The telephone is being extended to places whose names are the most remarkable thing about them. The rest of the country will breathlessly await the result of repeated efforts on the part of quick-tempered Mexicans to get over the telephone such names as Popocatapetl, Chihuahua, or Coatzacoalcos.—*Pittsburgh Telegraph.*

LIGHTNING IN AN EXCHANGE.—During a thunder-storm at Indianapolis, on April 5, a bolt of lightning ran into the tower of the telephone exchange, completely wrecking the connections and setting fire to the building. The flames were soon suppressed, doing little or no damage, but the loss by the lightning will amount to $500. The fire caused a panic among the telegraph operators and telephone clerks, but they all got out of the building without injury. Business was completely interrupted for a time.

TOLEDO, O.—With the opening of spring comes renewed activity in telephonic work. The extension of the Midland Telephone Company's system will be commenced in a few days. The contemplated lines will connect Toledo with Fremont, Oak Harbor, Port Clinton, Sandusky, South Toledo, Perrysburg, Bowling Green and numerous other small towns. Mr. F. F. Graves, manager of the Sandusky exchange, will probably succeed to the management of the Toledo exchange, vice H. N. L. Bernard, promoted.

AMBITIOUS DES MOINES.—The story telegraphed from Des Moines that that city was to have immediate telephone connection with New York via Chicago is said by telephone men here to be simply "wind." Some time during the summer the Central Telephone Company will extend its lines to Rockford, where they will be connected with those of the Western Telephone Company, in whose territory Des Moines is. Then that city will be able to communicate with Chicago and perhaps with New York, if the line to the latter is ready for business.—*Chicago Times.*

KISSING BY TELEPHONE.—This is the use to which the telephone is put in Iowa, according to the Lyons *Mirror:* An eavesdropper "took this off" the other morning when the thermometer stood at ten below:

He (in Lyons)—Is that you, dearest?
She (in Clinton)—Yes, love.
He—Put the mouth-piece to your lips.
She—Yes, what?
He (kisses)—That!
She—Oh, my! Was that lightning?
He—Did you get it, dearest?
She—Yes, love—cool and distant, but so sweet. Call again.

THE NATIONAL CAPITAL TELEPHONE COMPANY.—This company held its annual meeting at Washington on April 2, and increased its capital stock to $600,000. The Executive Committee was authorized to contract for the immediate building of a six wire line between Washington and Baltimore, which is expected to be in working order by the 15th of May, next. The company has a line between Washington and Alexandria, Va., and is making arrangements for the erection of trunk lines all through the State of Virginia, the plan being to connect all the important cities of Maryland and Virginia, and gradually extend it over the entire country. The plan is to charge upon the basis of ordinary telegraph tolls, or five minutes' use of the wire for 25 cents. The company is said to have sufficient capital at its back and means business.

DON'T LIKE THE TELEPHONE.—The most serious objection to the telephone is the facility it affords to bores. The Secretary of State of Indiana has ordered the telephone taken out of his office, because, he says, he is tired of saying "hello" to the whole State of Indiana, and the Legislature failed to pass the appropriation bill to allow him to hire a small boy to do his helloing for him. That was the only telephone in the State House, and the Governor, Supreme Court, Auditor, Treasurer and Attorney-General had the use of it, while the Secretary of State and his clerk's were made "lackey boys" to answer every Tom, Dick or Harry in the State who wanted to talk to the State officials. Governor Porter says he would not have a telephone in his office for $500. Like the stammering husband in Saxe's poem, he thinks it is "a dam-dam-damage instead of a blessing."

AN ACOUSTIC TELEPHONE COMPANY.—Out West the acoustic telephone is trying hard to catch up with the Bell. In addition to the Chicago corporation previously mentioned the "Ætna Telephone Company of Kentucky" filed its articles of incorporation at Covington on April 2, with Joseph R. Brown, William Means, C. E. Page, W. H. Doane and George F. d'Utassy. The capital stock is fixed at $50,000, divided in shares of $100 each, and Covington is to be the principal place of business. The scope of the company's business embraces the manufacture, sale, lease and operation of telephones in Kenton and Campbell counties. The new telephone, according to the Cincinnati *Commercial Gazette*, will consist of a reflector and a fine wire which carries sound a great distance with very little diminution of its force. Electricity will not be used. The incorporators are all well-known and prominent business men of Cincinnati, Mr. Means being the Mayor of that city.

DASHES HERE AND THERE.

W. U. OFFICE BURNED.—The Western Union Telegraph Office, at Shelbyville, Tenn., was destroyed by fire on April 6.

OBEYING LITERALLY.—Chief operator to country office—"Open No. 16 east and say when." Country office—"When."

NEXT ISSUE.—No. VI. of Professor Vander Weyde's series of articles on the Fundamental Principles of Electrical Science will appear in our next.

LEGAL DECISION.—An Oregon Judge has decided that a man cannot be arrested on a telegram. If this view should be universally adopted fewer fugitives from justice would be caught.

WIRES IN NEW YORK.—Telegraph wires are so numerous on some of the streets of this city that people living on a fourth floor flat can sift their ashes by merely throwing them against the network.—*N. Y. Com. Adv.*

PHILOLOGICAL.—A Western paper, noting that electricians measure electrical quantities by "ohms" wants to know if this is the reason that whenever the lightning scares a woman she invariably shrieks, "Ohm my!"

UNDERGROUND WIRES IN NEW YORK.—In the Board of Aldermen of this city, on the 10th inst., the franchise to permit the "New York Electric Lines Company" to lay wires under the streets of the city was passed over Mayor Edson's veto by a vote of 19 to 5.

BANKERS AND MERCHANTS.—At a meeting of the directors of this company, held in this city April 1, the following officers were elected for the ensuing year: William W. Moris, president; A. W. Dimock, vice-president; J. G. Case, secretary and treasurer, and G. S. Mott, superintendent.

RAILROAD TELEGRAPH SUPERINTENDENT'S ASSOCIATION.—The annual meeting of the Association of Railroad Telegraph Suprintendents, which was to be held in Chicago the third Wednesday in May, has been postponed until Wednesday, June 13, in order that the members may have an opportunity to visit the Exposition of Railway Appliances.

A USEFUL FENCE.—According to a Western paper, a line of wire fence, 85 miles in length, is being constructed in Kansas by a farming company, which will also be used for telegraphing, operating telephones and electric signals. The current will be strong enough to severely shock any person or animile that touches it.

NO LINEMAN NEED APPLY.—A Pittsburgh girl who had refused a good-looking telegraph repair man three times within six months, gives as a reason that he was too much of a wanderer. That he roamed from pole to pole, from one climb to another, and if he did come home, he'd be insulate that the neighbors would be sure to talk.—*Pittsburgh Telegraph.*

BUFFALO'S NEW W. U. OFFICE.—The Western Union has moved its main office in Buffalo, N. Y., into Brown's building, just across the street from its old location. That the new office is a considerable improvement over the old one will be apparent when it is remembered that $25,000 was spent in improving the Brown building before the office was ready for occupation. The Western Union has now 125 employés in Buffalo. The Mutual Union office has not yet closed, and probably will not for some little time.

THE VALUE OF PUNCTUATION.—A correspondent of the Philadelphia *Times* says that one of two cousins, named Jack and Ed. who were hunting in the Adirondacks, was accidentally killed by the discharge of his own gun. This was Jack. A telegram from a friend to his mother was read: "Jack accidentally shot Ed., and George will arrive with the body to-morrow." It should have read: "Jack accidentally shot; Ed. and George will arrive with the body to-morrow." One member of the family read it this way, and the suspense lasted until a messenger dispatched to the telegraph office brought back the correct reading.

MAKING TROUBLE ON THE WIRE WITH AN AX.—On the afternoon of April 6, William Herbert, with an ax on his shoulder, suddenly rushed into the telegraph office at Locust Dale, Penna., which is in charge of Mr. Peter J. Joyce and his brother William. Herbert strudk the relay and sounder a vigorous blow with the ax and broke them into a thousand pieces. The infuriated man was taken in charge, but created some excitement by his insane actions on his way home. He was crazy from drink, and imagined that an electrical battery was attached to him and that it was in Joyce's power to remove it. It was to sever that connection that led him to make the attack.

WAS IT A METEOR?—The New London, Conn., *Telegram*, of March 8th, says: An examination of the batteries of the fire alarm telegraph at the City Hall in Norwich yesterday morning showed that one of the composition screws used for hanging the pieces of zinc in the liquid of the batteries had been cut entirely off as though by a bolt of electricity. The broken end was twisted and scored, and polished clean of rust. In the opinion of good judges the damage was wrought by the passage of the meteor that shook Norwich one night recently. It is believed that the meteor was accompanied by a tremendous flood of electricity, part of which passed over the electric wires. The agency of electricity alone could have melted the screw head.

STOCK QUOTATIONS.—Telegraph, telephone and electric light stocks were quoted on Wednesday of last week and Wednesday of this week as follows:

	April 4.	April 11.
Western Union Telegraph	83⅛	83¾
Mutual Union Telegraph	20½	19¼
American Cable	66½	67¾
American District Telegraph	31	31
Edison Illuminating Co	50	50
U. S. Electric Light	131	131
People's Telephone	21	....
Shaw Telephone	25	25
Mexican Telephone	3½	4
Tropical Telephone	2¼	2⅛
American Bell Telephone	215	228½
Bay State Telephone	....	122

JAY GOULD'S NEW YACHT.—The launch of the Atalanta, Mr. Jay Gould's new yacht, was the great event in Philadelphia on Saturday last. The yacht was christened by Miss Nellie Gould, the daughter of Mr. Jay Gould. There were also present Mr. and Mrs. Jay Gould, Gen. Eckert, Mayor King, Samuel J. Randall, Judge Kelley, and many others. The new craft rides the water like a sea gull, and is fitted for the accommodation of twenty-two guests. She is the largest steam yacht afloat, and cost in round numbers a quarter of a million of dollars. She will be lighted throughout by electricity, and each stateroom will be supplied with electric bells to the servants' quarters and steward's pantry. Steam fans will keep the air moving at all times, and, in short, everything that ingenuity can suggest and cash command will be suggested and commanded.

ELECTRIC RAILROAD SIGNALS IN ILLINOIS.—Judge Tilden, of Cincinnati, representing the Union Switch and Signal Company, of Pittsburgh, appeared before the Railroad Committee of the Illinois State Senate last week, and presented the company's plans for the protection of railroad trains at grade crossings. The plan is a combination of distance and danger signals and switch locks which are operated by electricity and hydraulic power. Diagrams were presented showing that an approaching train upon one track to a crossing will ring an annunciator to warn the operator to either clear the corresponding signals or stop the train by allowing the signals to remain at danger. The committee was favorably impressed with the scheme and Judge Tilden's presentation thereof, and Mr. Tanner, the chairman of the committee, introduced in the Senate a bill permitting these interlocking and automatic signals, and providing that where adopted trains shall not be required to stop, as now required by law. Enactments similar to this, it was shown, have been enacted in Massachusetts, New York, Pennsylvania, Ohio and Indiana. In Massachusetts the law is compulsory.

WANTS A TELEGRAPH CABLE TO BERMUDA.—The Providence R. I. *Journal*, of March 15, says: Last week our Signal Service met with its greatest humiliation. The weather indications published Friday evening, March 9, after prophesying warmer weather, with local rain or snow, for Saturday, closed as follows: "There are no indications of any great storm energy." Only a few hours later, on Friday night, a West India cyclone struck the North Carolina coast, and during Saturday swept the whole coast line as far north as Nova Scotia. The barometer at the Block Island Station and in this city went

below 29 inches, a very rare occurrence. On Sunday came the information from a signal officer at Washington that the great storm had been raging for two or three days around the Bermudas before it touched our coast. For the lack of cable communications with Bermuda a dangerous storm burst upon us, as it has done often before, without the possibility of warning to our exposed shipping. A signal service cable to Bermuda would be an incidental aid to our commerce with those islands, and would, if not self-supporting, earn something toward its cost. Is it not worth the while of our Boards of Trade to direct attention to this needed extension of our Signal Service communications.

AN AMUSING ERROR.—Miss ——, the regular day operator in the St. Louis office, was absent a few days recently, and her place on one of the way wires was filled by Miss ——. The change, as is usually the case, attracted the attention of the whole line, all being anxious to know who the newcomer might be. The names and places being strange to the lady, and the operators at the way offices very far from perfect, she had a hard time of it for a while. To one who sent her a message, "consider mean applicant," checked four words, she said "only 3 words," and found them that "mean" was two words. But as she became acquainted with the different styles of sending, things passed on more smoothly, until one morning when she had almost cleared the message-hooks at her table of the morning's business, she came to a code message for a remote country office, which for the present we will call "X N." This little office is presided over by a very modest operator who misses little that goes on over the wires. Hearing his call, and knowing that the strange young lady was at the key, he smoothed his hair, stroked his beard, tipped his hat and gracefully answered, "I, I—'X N.'" The body of the message read: "Frog elephant horse monkey bear." On the fifth word "X N" broke and said, "g. a.—D." She then wrote slowly, "b-e-a-r," and added, "did u get that d-e-a-r?" "Yes, darling," was the response. "O! I mean that word is b-e-a-r and not d-e-a-r." "Excuse me, madam, I thought you meant to call me *dear!*"

NEW YORK CITY ITEMS.

Echoes from 195.

Mr. J. C. Clark, of the night force, is studying medicine at the University of New York City.

Mr. J. L. Edwards, Washington printer, is again on the sick list, suffering from a severe cold.

Mr. H. L. Knight has obtained a position on the night force. A Knight man on the day force would be anomalous.

Mr. James Merrihew, assistant general superintendent, has returned from Havana, where he has been for over a month.

Dr. Bradneck, of the night force, is engaged as examining physician by the Telegraphers' Mutual Benefit Association for New York and vicinity.

Mr. J. L. Edwards has been elected vice-president of the Telegraphers' Aid Society, *vice* Mr. A. T. Creelman, resigned on account of leaving New York.

Mr. Frank Swayne, of Rochester, N. Y., who formerly worked in old 145 Broadway, gave 195 a call last Monday and was cordially greeted by his many old friends here.

Messrs. Scanlon, Costello, Young and Welch, manipulate the third Boston quad, Messrs. Dalton, Jansen, Umfred and Ranken the regular Boston quad. "W" of Boston is the *bête noir* of Messrs. Scanlan and Ranken.

Mr. D. B. Mitchell, having been exposed to the New Jersey elements for three consecutive days, while testing wires on the Hackensack bridge, has returned to the Southern switch with his face the color of a berry—a red berry.

Mr. R. A. Shipman, an old army telegraphist, who is now connected with a Detroit electric light company, being in this city investigating the different electric lighting systems here in the interest of his company, visited 195 last Monday and was shown the office by Chief Fred Catlin.

Mr. Harry Todd, formerly an office boy, who left New York seven years ago and subsequently studied for the ministry, visited 195 last Tuesday. Mr. Todd has for some years been the pastor of a church in Wisconsin, and expects soon to go to Texas on mission work. He is so bronzed and bearded that his old friends hardly recognized him.

Last Friday night the task of taking down the massive flooring of the scaffolding was accomplished, but owing to a leak having occurred in the steam pipes on the floor above the operating room, somewhat damaging the newly painted ceiling, the order to remove the now familiar supports of the scaffolding was countermanded and they still remain. However, the removal of the platform is a great benefit, as it dispenses with the dust that was continually falling therefrom, besides improving the light, and the quality of the air in the room.

Other City Items.

Mr. Jack Healy is working nights at the Fifth Avenue Hotel.

The 1,227 Broadway W. U. office is the model office, having been newly painted and repaired.

Mr. C. K. Clark, late inspector of the American District, has accepted a similar position with the Mutual District.

Mr. Arthur M. Lewis, of 819 Sixth avenue W. U. office, will leave for Europe about the first of May, to return early in September.

Several of the city operators have caught the bicycle fever. A bicycle club will shortly be started, with Mr. James Knoll as President.

The Western Union office for many years located at 791 Broadway is shortly to be removed to new quarters on Broadway, under the Morton House.

"Phil Walther" is as near to it as a Western paper of Teutonic predilections can come to it in forwarding its remittances for the United Press News to its business manager, Mr. Walter P. Phillips.

A package addressed to Miss Gould, and at first thought to be an infernal machine, exploded in the post-office in this city, April 10. The circumstance considerably annoyed Mr. Jay Gould. An investigation, however, showed that the supposed infernal machine was simply a burglar alarm, and had been sent without any mischievous intent.

The masquerade ball of the American Rapid Telegraphers, at Lyric Hall, April 3, was a highly successful and enjoyable affair. Mr. M. F. O'Brien, floor manager, as Prince Condi, and Mrs. Lily, of New Haven, as Queen of Folly, led the march. We regret that an extended report of the ball only reached us as we were going to press, and was, therefore, too late for publication.

At the meeting of the New York Electrical Society, April 6, it was decided to make its library a circulating one. Mr. F. W. Cushing described the latest developments in harmonic telegraphy, and Mr. C. O. Mailloux read a paper by George A. Hamilton, on cable testing. We publish the full text of Mr. Hamilton's paper in another column. The cuts to illustrate Mr. Cushing's lecture not being all ready, we cannot give it in this issue. The next meeting of the society will be held at Stevens Institute, Hoboken, N. J., on Friday evening, April 20th, when Professor Henry Morton will deliver a lecture on "The Storage of Electricity." Complimentary tickets of admission to this lecture can be obtained by applying to J. McKenzie, Jr., financial secretary, 195 Broadway.

PERSONAL.

ALLIANCE, O.—Mr. A. G. Odenbaugh, for some years manager of the Western Union Office at Alliance, died at Urbana, O., on April 1.

KANSAS CITY, MO.—Mr. H. J. Bosworth, formerly employed in the W. U. office here, and who has been ill since last June, died at Kirksville, Mo., in February.

A LINEMAN'S FALL.—Daniel Mullen, a Western Union lineman, fell a distance of 25 feet from a pole, near Philadelphia, on the 6th inst., and was very seriously injured.

LIMA, O.—Mr. H. T. Moore has resigned the management of the Western Union office here, to take a position on the C. & A. Railway. Mr. E. V. Anders, formerly manager of the Mansfield, O., office is his successor.

AN OPERATOR DROWNED.—Mr. E. N. Henry, of Cleveland, O., an operator at Painted Cave, Tex., was drowned on April 5 in the Rio Grande, at the mouth of the Pecos. The body was not recovered on account of the swift current.

GRAND TRUNK RY.—Mr. G. A. Snyder, operator in the General Manager's office, G. T. R., Montreal, is agent for THE OPERATOR AND ELECTRICAL WORLD. Subscriptions from operators on the Grand Trunk Ry. can be sent to Mr. Snyder.

A PLUCKY OPERATOR.—The night operator of the Baltimore & Ohio Railroad, at Glenwood, Pa., was attacked by a tramp on April 4, at 2 o'clock A. M., who presented a revolver and demanded money. The operator picked up a chair and drove his assailant out.

SEDALIA, MO.—Mr. Miller Bullard, telegraph superintendent on the Missouri Pacific Railroad, well known throughout the entire west, died at Sedalia on April 3. Mr. S. F. Sheldon, one of the oldest telegraphers in the country, has been appointed to fill the vacant position.

NEWARK, O.—Mr. Charles E. Wise, formerly of Newark, but now manager of the Western Union Telegraph Company's office, 103 Chestnut street, Philadelphia, and Miss Hattie C. Evans, youngest daughter of Hon. Lewis Evans, of Newark, were married at the residence of the bride's parents, on April 5, and left for their future home in Philadelphia.

OFF TO EUROPE.—Dr. Norvin Green, president of the Western Union Telegraph Company, sailed on the 10th inst. for Liverpool on the Guion steamer Alaska. Dr. Green will be absent about three months. He will probably go directly to London, where he will be met by Mr. Henry Weaver, managing director of the Anglo-American Cable Company, and by Mr. John Pender, manager of the Direct Cable Company. Mrs. Green and the Misses Green have gone to Louisville, Ky.

BOSTON, MASS.—Mr. T. J. Calahan, whose illness we mentioned last week, is steadily improving. Mr. James G. Morgan, late of the Mutual Union at Washington, goes to Boston for the United Press, withheadquarters in the *Globe* office. The *Globe* has developed a new streak of enterprise in culling from its exchanges by telegraph. Among things which it is taking by wire is the Sunday *Sun's* amusing dialect sketch of "the Barber near the Cooper Institute." Next to pigeon English, this is perhaps the most difficult matter to transmit that has ever been handled by telegraph, but Messrs. Parmelee and Taylor, of New York and Boston respectively, manage to print in the *Globe* a precise *fac simile* of what appears in the *Sun*.

APPOINTMENTS.—Mr. J. M. Osborn has been appointed superintendent of telegraph, and Mr. S. K. Blair chief train dispatcher of the Toledo, Cincinnati & St. Louis Railroad; Mr. A. H. Hunsacker, formerly chief train dispatcher of the New York, Chicago & St. Louis Railway, has been promoted to be train master; Mr. H. A. Cooper, late superintendent of telegraph of the Toledo, Cincinnati and St. Louis Railroad, has been appointed secretary to General Manager Ferris, of the N. Y., Pennsylvania & O. Mr. James Black, formerly operator at Fergus, Ont., and latterly train dispatcher at Denver, Col., has recently been appointed train master on the Denver & Rio Grande Railroad. Mr. Black is the youngest man ever appointed to the position on that road. Mr. T. C. Clark has been appointed train master of the Wheeling & Lake Erie, between Marietta and Zoar. Mr. E. T. Gates succeeds Mr. Clark as train dispatcher. The office will hereafter be at Massillon, instead of Cambridge.

EDISON IN MONTREAL.—On Tuesday morning, the 2d inst., Mr. Thomas A. Edison arrived in Montreal, accompanied by several others from New York. The party registered at the Windsor Hotel, and shortly afterward Mr. Edison accompanied by Mr. Thomas Swinyard, of Hamilton, visited the Canada Mutual Telegraph office, where they were received by Mr. Hosmer, the president. In the afternoon Mr. Edison was entertained at the St. James Club, where there were present a number of the principal merchants, stockbrokers and capitalists of Montreal. Later in the afternoon Mr. Edison and a large party, upon the invitation of the Directorate of the Canadian Cotton Company, and the Canadian Electric Light Company (Edison patents), inspected the new weaving room of the Canada Cotton Mills at Cornwall, in which the Edison incandescent light has recently been introduced. The inspection was highly satisfactory. The new weaving room attracted much attention. Refreshments for the party were provided at the station, and at 9.30 p. m. they left for Montreal. They left the latter place for New York on Wednesday morning, highly pleased with the trip.

FREDERICKSBURG, VA.—This "Old Burg" is now well supplied with telegraphic facilities, there now being two offices—the Western Union at the Exchange Hotel, and the Southern at 73 Commerce street. The latter is doing the business of the town, as its rates are much cheaper, and the office is more centrally located. Mr. W. F. Boyce is the polite manager of the Western Union. Mr. George B. Jones, formerly messenger in the A. U. Co., under Mr. Boyce, is the accommodating and pushing ahead manager of the Southern. Mr. Jones has done much to accommodate the merchants of the town by establishing a district call-bell service. This brings into his office over two-thirds of the trade. A handsome Bunnell sounder was voted him by friends at the bazar of the Fredericksburg Grays, as a testimonial of appreciation. Mr. Jones and Mr. Boyce are both natives of this place. Mr. Joe McGovern, an old timer, is seen on our streets daily. Mr. Charles Slaughter, of this place, and formerly manager of the A. and P., in this city, but late of Dallas, Texas, stopped off a few hours with his father, "Judge" Slaughter, on Sunday, while on his way to Richmond, Va., to take a position of chief operator in the Southern Co.'s office. W. U. men in Texas speak of Mr. Slaughter as the crack operator of Texas. An effort is being made by Manager Jones, of the Southern Company here, to establish a telephone exchange. D. U. PLEX.

BORN.

MEDLEY—April 2, to Mr. O. S. Medley, agent and opertor, Iron Mountain Ry., Hogan, Mo., a son.

ELECTRICAL PATENTS ISSUED.

Week ending Tuesday, April 3, 1883.

Automatic signaling apparatus; Frank B. Wood, N. Y.	275,005-6
Armature for dynamo-electric machines; Edgar A. Edwards, Cincinnati, O.	275,169
Automatic signaling apparatus for telephone circuits; Theo. N. Vail, Boston, Mass.	275,296
Automatic printing telegraph; Alfred F. Johnson and Frank B. Johnson, Brooklyn, N. Y.	275,339
Duplex telegraph; Joseph E. Fenn, Elizabeth, N. J.	275,334
Electric connector for railway track circuits; Stephen D. Field, N. Y.	275,180
Electric arc lamp; Joseph R. Finney, Pittsburgh, Pa.	275,182-3
Electric arc lamp; J. Allan Dalzell, N. Y.	274,916
Electric arc lamp; Silvanus F. Van Choate, N. Y.	274,997
Electric arc lamp; F. G. Waterhouse, Sacramento, Cal.	274,999
Electric arc lamp; Edgar A. Edwards, Cincinnati, O. (6 patents)	275,168, 275,170-1-2-3-4
Electric lamp globe; George J. Murdock, Binghamton, N. Y.	274,959
Electric elevator; Stephen D. Field, N. Y.	275,179
Magneto-electric machine; Siegfried Marcus, Vienna, Austria-Hungary	275,237
Polarized relay for quadruplex telegraphs; George W. Gardanier, Brooklyn, N. Y.	275,185
Pole for galvanic batteries; Burton F. Blackall and John C. Decker, Rochester, N. Y.	274,899
Receiving instrument for quadruplex telegraphy; Stephen D. Field, N. Y.	275,181
Supporting and preserving telegraphic conductors; James H. Green, Brooklyn, N. Y.	275,195
Safety self-closing shunt switch for electric light circuits; Elihu Thomson, New Britain, Conn.	275,289-0
Secondary battery element; Charles F. Brush, Cleveland, O.	274,905
Speaking telephone; Stephen D. Field, N. Y.	275,178
Telephone transmitter; Edward L. Wilson, Boston, Mass.	275,310
Underground conduit; John Lynch, Washington, D. C.	275,233
Underground conduit for electric wires; Henry Clay, Philadelphia, Pa.	275,023

BUSINESS NOTICES.

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MR. JAMES ELVERSON, publisher of *Golden Days*, has commenced the publication of a popular illustrated weekly called *The Illustrated World*. Eight of the sixteen pages are filled with wood engravings of a very high order of merit. The other eight pages contain choice original reading matter. The subscription price of *The Illustrated World* is only $3 a year; specimen copy, with art plate, 10c. Every reader of THE OPERATOR AND ELECTRICAL WORLD ought to send for a specimen copy. Mr. Elverson will be remembered by many of our readers as an old-time operator. He is now one of the wealthiest and most enterprising publishers in this country. See advertisement in another column.

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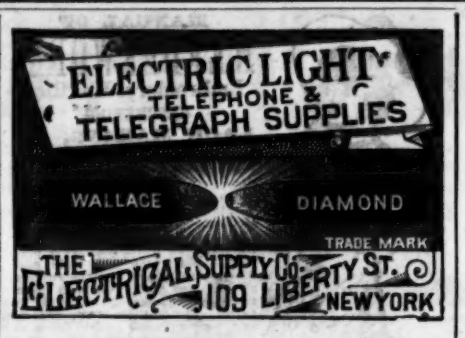

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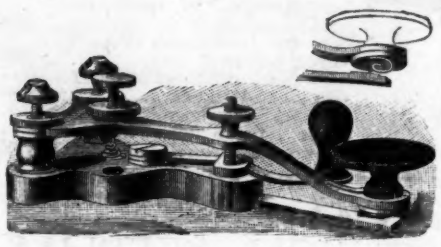

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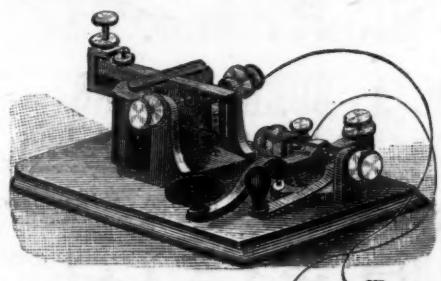

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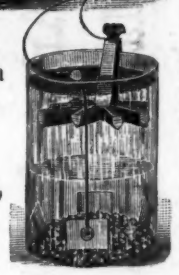

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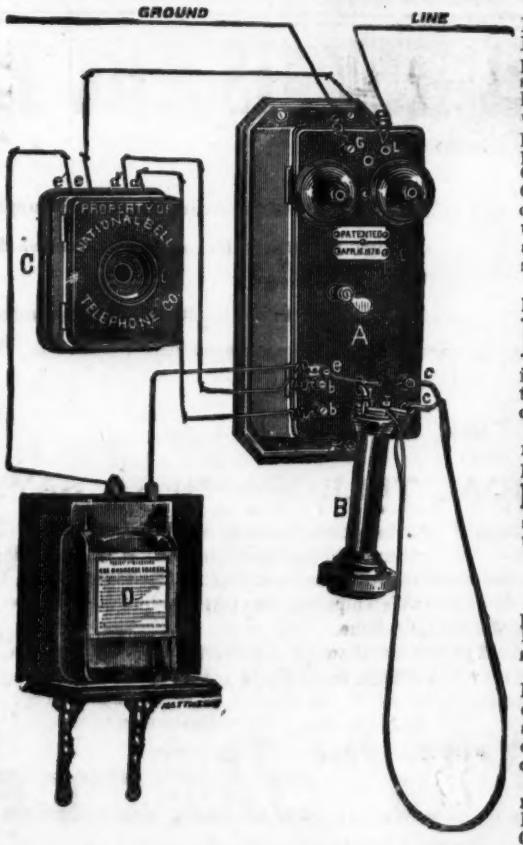

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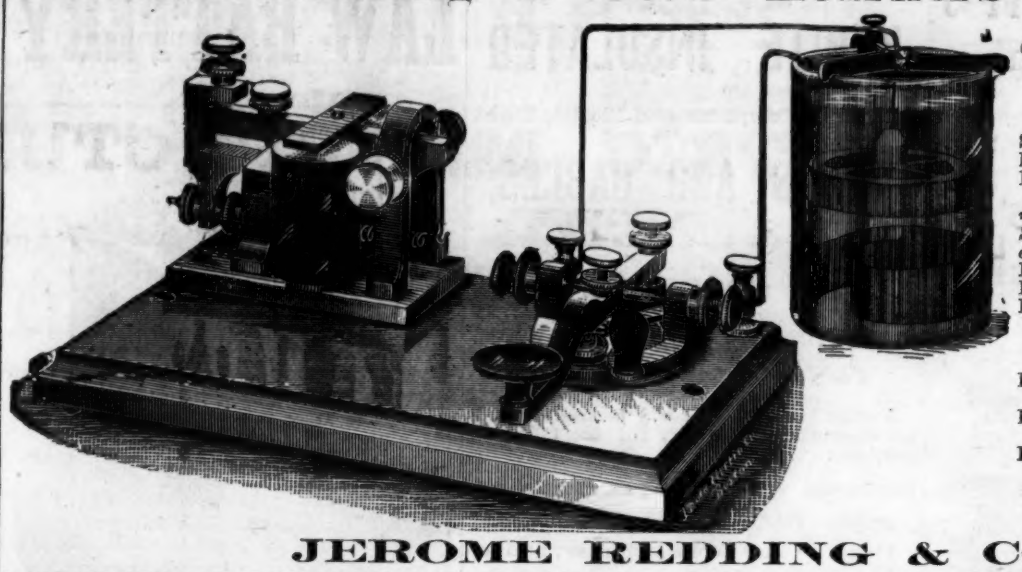

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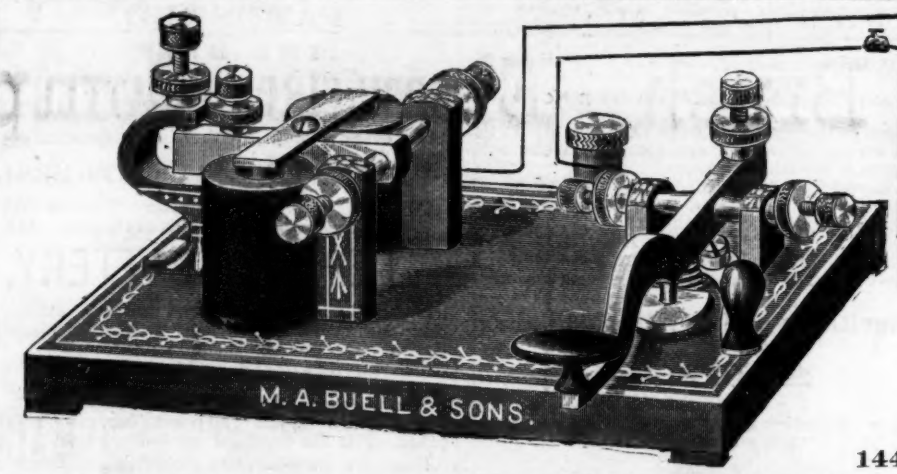

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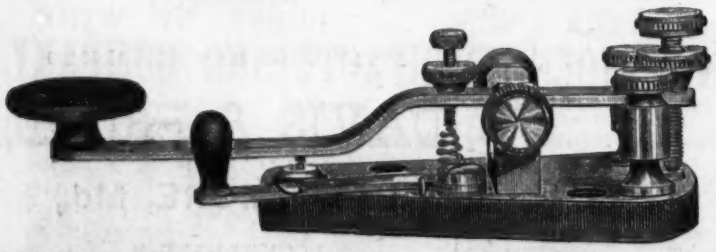

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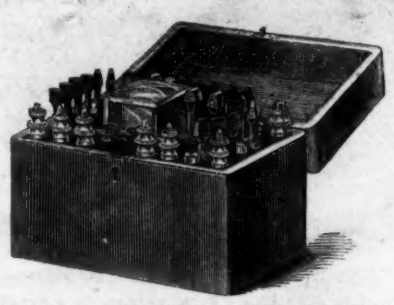

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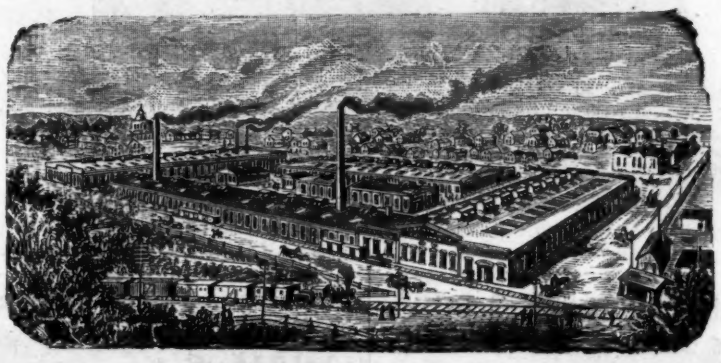

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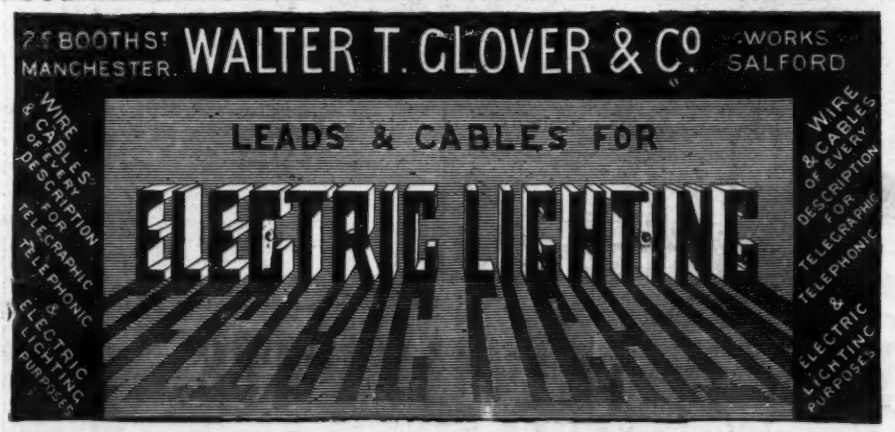
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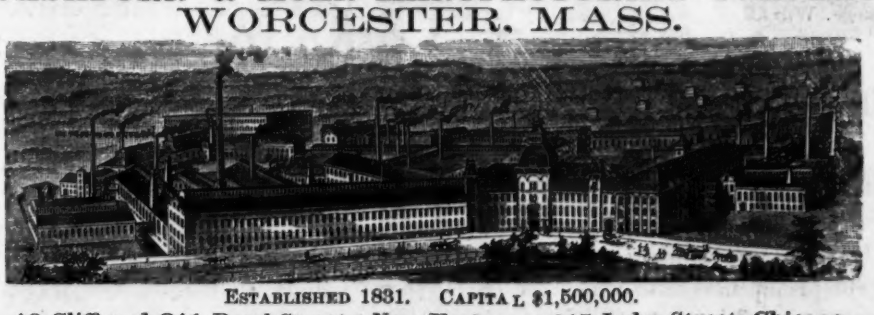

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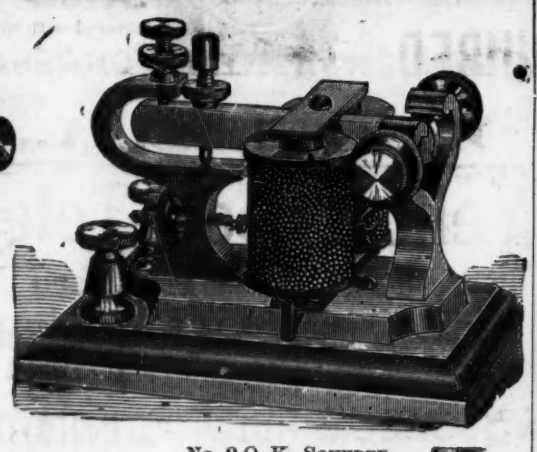

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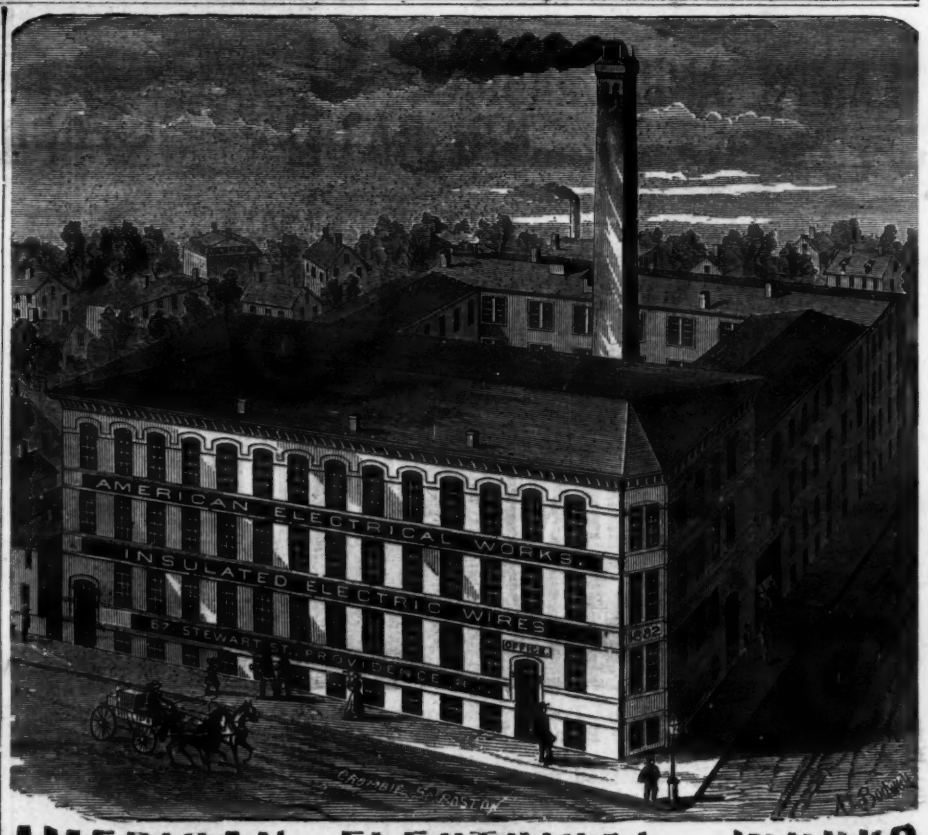

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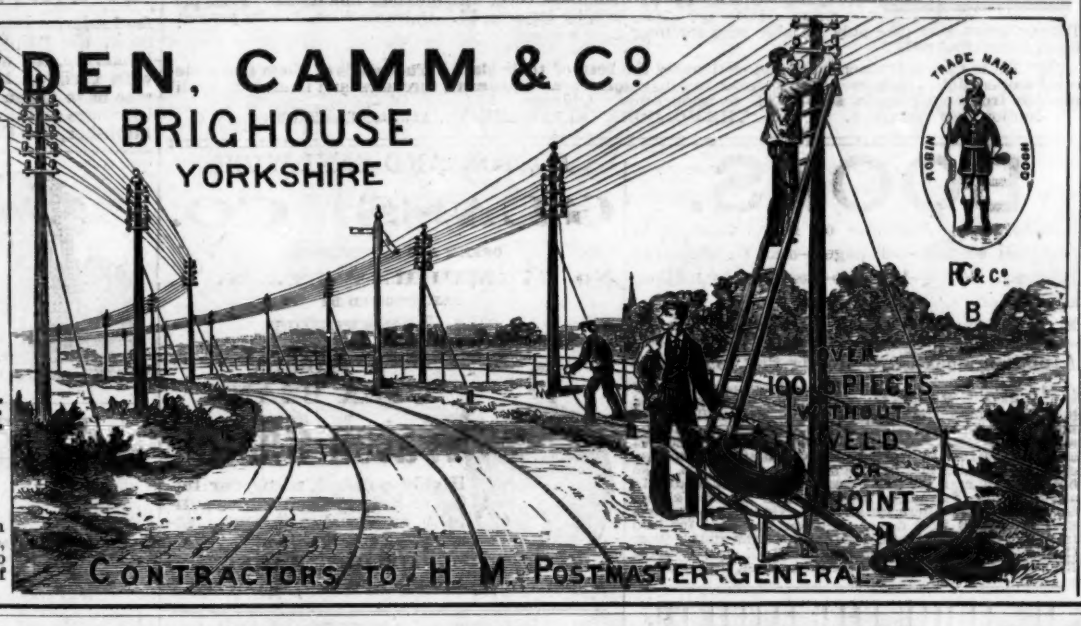

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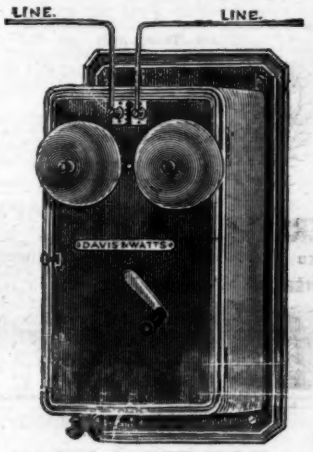

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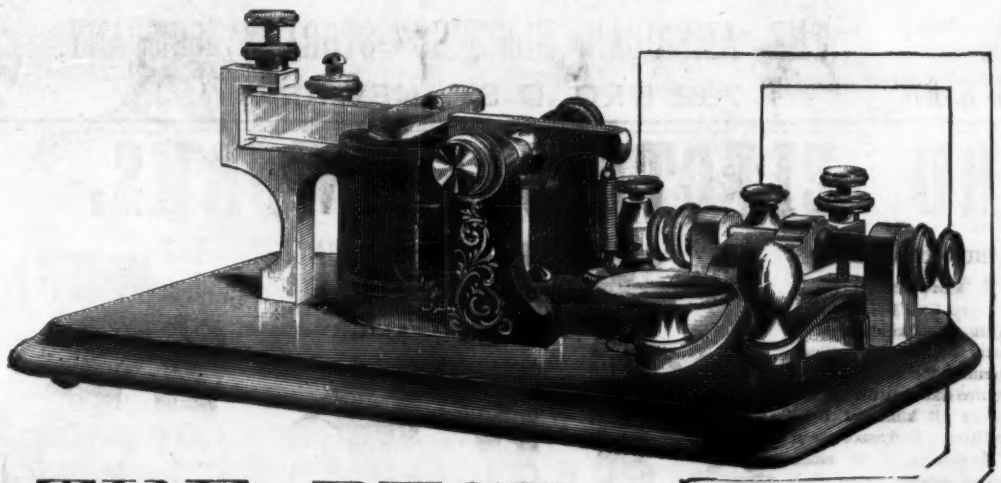

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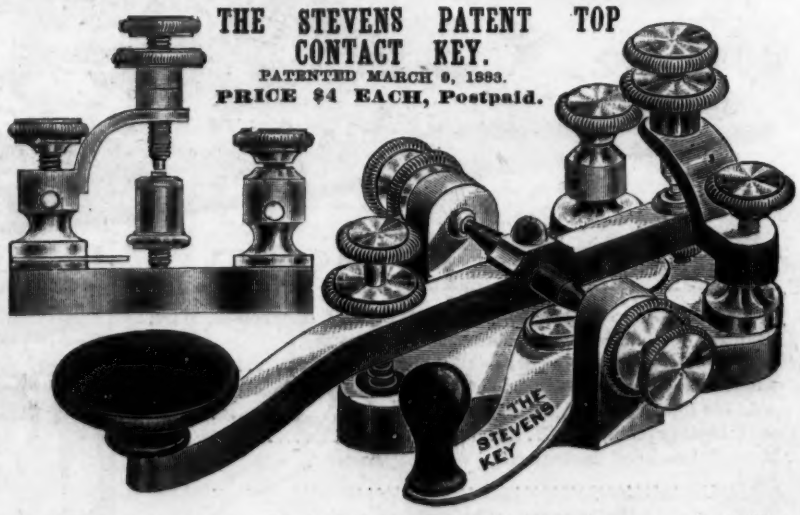

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